Hon. Attorney General

PROCEEDINGS AND TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

J. J. B.
July 5/55

OF

HALIFAX, NOVA SCOTIA.

VOL. V. 1879-80. PART II.

CONTENTS.

APPENDIX.

HALIFAX, NOVA SCOTIA.—WILLIAM GOSSIP, 103 GRANVILLE STREET.
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UNITED STATES.—THE NATURALIST AGENCY, SALEM, MASS.

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ANNIVERSARY ADDRESS, 1879.

By Wm. Gossip, F. R. M. S., *President.*

Two years have elapsed since I had the honor of addressing the Institute on our anniversary, with reference to its proceedings and prospects. Then, in the absence of the worthy President, being next in office, I thought it right that one of our rules bearing upon this duty should be observed, lest it might be lost sight of altogether. Since that time you have done me the honor to choose me your President, and now it is more than ever a duty imposed upon me not to allow a rule deemed essential to the well-being of the Institute to remain inoperative, although what has to be said may not, on every occasion, be specially interesting, or largely instructive.

Science is ever progressive. True science is never lost. What the mind of man has once conceived and practically realized is almost always retained, and is never entirely forgotten. Indeed, the empire of science is so widely extended, and its influence so general, as to be beyond the possibility of decay or extinction. All nations interest themselves in its advancement, and by generous impulses contribute to its resources. Knowledge has wonderfully increased, and we may well be proud that our own mother land leads the van in the cause, and more than all others, has largely aided and encouraged the almost universal enlightenment.

When the world is prepared for great discoveries they are usually vouchsafed. The art of Printing, which is now so expansive, perpetuates invention; and steamships and railways, electricity and magnetism, annihilate space, and bring to a focus of general utility the scientific conceptions of every clime. Human intellect has so far mastered the arcana of nature as to be able to control, to a certain extent, some of her most subtle agencies, and make them obedient to its own guidance. With apparent facility, an electric current is conducted thousands of miles, through air and water, and causes a message to be deliver-

ed with exactness and truth in intelligible language. The same subtle fluid, by the same agency, bids fair to be an useful auxiliary of the less mighty steam-engine—a mechanical power, and a means of propulsion; and will, perhaps, in a short time, be economized to dispel the darkness of night in our large cities. The telephone enables individuals to converse, each one from his own chamber, over widely intervening spaces; and ere long sound may rival electricity in instantaneous communication. Except in imagination there is no power that thus mocks at distance. If we would find something analogous we must invade the realms of fiction. The authors of the *Arabian Nights Entertainments* do no more, who send princes and princesses through the air on enchanted horses, by the twist of a peg, thousands of miles in a moment—literally with the speed of thought; and our own immortal Shakspeare, perhaps dreaming of an ocean cable, evokes an adventurous sprite, able to "put a girdle round the earth in forty minutes." These were the wildest vagaries of imagination, which have become in the nineteenth century sober realities.

The imaginative standard of the past having thus been reduced to a fixed value, I may be permitted further to illustrate the practical necromancy of modern times.

Daguerre, in 1839, after years of experiment, at length by a wonderful but simple process, transmitted the human portrait from life to plates of silvered copper, made sensitive to solar light by the vapour of iodine. Soon thereafter, the principle thus fully developed, improvements sprang up on every hand, and the results so far are beautiful photographs, made permanent by autotype, which give the most accurate delineations of works of art as well as natural objects. It is not to be supposed that they will stop here, or that science has done with them. Genius will in time be able to fix the colours of the camera, as well as its shadows.

Again, experiments on light, following a growing knowledge of the laws by which it is governed, have produced the spectroscope, and now scientists assume, from careful analysis of the solar atmosphere, that they have a clue to ascertain the substance of the sun.

In connection with this subject, the experiments of Mr. Lockyer, a distinguished savant, and editor of *Nature*, a journal well known in the world of science, with reference to the solar and stellar spectra, are of much interest. He has started an hypothesis, and justified it by experiment—that the elements themselves, or at all events some of them, are compound bodies, and that hydrogen is the principal elementary substance represented

in these spectra. I cannot find in what Mr. Lockyer has written that he goes farther than this, if quite so far. But the *Medical Tribune* of April 15—a journal of scientific pretensions, published in New York—contains a well written article, by Dr. Wilder, its editor, based upon the Papers in the No. of *Nature* I have quoted, in which the argument of Prof. Lockyer is asserted to be, "that in hydrogen we have matter reduced to its lowest terms—*the only one element.*" I do not think myself that Prof. Lockyer has made this a distinctly definite conclusion, but it affords, at all events, to the writer in the *Tribune*, an opportunity to assume for the hypothesis, or theory, of our associate, Mr. Dewar, and his friend Dr. Fraser, a like degree of credence. These gentlemen have long since announced, in their ato-magnetic theory, that all primal atoms are either hydrogen or oxygen, mineral or vegetable, which approaches the hypothesis or theory of Prof. Lockyer, as stated by the *Tribune*, but is of earlier date, and were it substantiated by experiment, would be as little objectionable. The writer in the *Tribune*, favorable to Mr. Lockyer's hypothesis as to the principle involved, objects "that as hydrogen is not a luminous substance, and, therefore, is of itself without motion, and, being molecular, must have been built up from atoms of a still more elementary character, there must be some force acting upon it to set its atoms in motion." Here again comes into play Messrs. Dewar and Fraser's plausible theory of the magnetic polarity of atoms. He quotes the suggestions of other scientists to account for this motion; also, that electricity, by inducing the primal atoms to assume polarity, may cause the first motion by means of the attraction and repulsion of the two poles, the positive and the negative; and gives a reason to show that the element denominated hydrogen, when negatively electric and uncombined, is identical with the substance known as oxygen. Thus the theory is similar to that of Prof. Lockyer, but with a difference. I do not pretend to understand the processes which have prompted these several speculations, generally alike. Neither appears to have advanced much beyond the confines of enquiry, and we may be content to await with patience their further investigation. To those interested in its progress, I would recommend a study of the articles in *Nature* of January, 1879, and to supplement them with that in the *Medical Tribune* of April 15, following. Perhaps in time the spectroscope may help us to a satisfactory solution of the difficulties.

To the spectrum and the microscope we may look for some of the most valuable discoveries ever made in the realms of science.

At the risk of being thought discursive or digressive, I beg leave to refer to an event of great interest, with which we may be all more or less familiar, which makes us better acquainted with microscopic revelations, and brings us so close to the beginning of life, that the power to produce it from lifeless elements appears to be almost within our grasp.

The English papers, by the royal mail steamship which arrived early in September, are occupied with lengthy accounts of the anniversary meeting of the British Association at Sheffield on the 20th August. These anniversaries have lost none of their interest for the British people. We learn from them the importance attached by all classes to scientific investigations. The Press uses its powerful combinations to spread abroad, with the utmost rapidity, over all the Empire, and to foreign countries, full details of the proceedings, employing for that purpose the energies which art and science have placed at its disposal. The railway and locomotive, the marine engine and screw propeller, the ocean cable and electric telegraph, all triumphs of science and genius within a century, engage in the work. Photography also, takes the portraits of the President and other scientists of the Association, and then by electro-metallurgy makes them typography, placing before us in a newspaper correct likenesses of the men who, in Great Britain, contribute to the scientific advancement of the nation. Do we desire to know the subjects which engage the minds of these men? The press communicates them in twenty-four hours after their delivery. They reach us by electric telegraph as quickly on this side of the Atlantic. In twelve days at farthest, by steam navigation. I may call all this the artistic application of Natural Science. The substance of the President's address is before me. It treats of Protoplasm. He describes "Protoplasm, or living matter, as lying at the base of all living phenomena." * * "a tangible and visible reality, which the chemist may analyse in his laboratory, the biologist scrutinize beneath his microscope and dissecting needle. All over the world, in fresh water and in salt, minute particles of protoplasm may be detected. In the famous amœba, which has arrested the attention of naturalists, almost from the commencement of microscopical observation, we have the essential characters of a cell, the morphological unit of organization, the physiological source of unicellular existence. But cells combine into organs, and organs into animals. Yet in the most complex animal the cell retains its individuality. * * * *

This, though not entirely new, is a lucid description of

great interest, and what follows ought to command earnest attention besides :—

"Examine under the microscope a drop of blood freshly taken from the human subject, or from any of the higher animals. It is seen to be composed of a multitude of red corpuscles, swimming in a nearly colourless liquid, and along with these, but in much smaller numbers, somewhat larger colourless corpuscles. The red corpuscles are modified cells, while the colourless corpuscles are cells still retaining their typical form and properties. These last are little masses of protoplasm, each enveloping a central nucleus. Watch them. They will be seen to change their shape. They will project and withdraw pseudopodia, and creep about like an amœba. But more than this, like an amœba, they will take in solid matter as nutriment. They may be fed with coloured food, which will then be seen to have accumulated in the interior of their soft transparent protoplasm; and, in some cases, the colourless blood corpuscles have actually been seen to devour their more diminutive companions the red ones."

All this is very wonderful, and to many whose opportunities of microscopic observation are rare must appear entirely new. They may have been prepared for the modified cell of the red corpuscle, but the protoplasmic—the living condition of the white —feeding as it were, upon itself, has only been revealed by the highest powers of the microscope. We have it on Supreme authority as to the animal, that "the blood is the life thereof," but whoever could have supposed that this Divine truth would be proved to the senses after this manner. I should imagine that the knowledge is of the highest importance. Our M. D.'s are called upon now to adjust the equilibrium between the red and white corpuscles—to lessen or increase the cannibal instincts of the white, and so to cleanse the impurities that interfere with a healthy circulation, and which are the fruitful generators of disease.

The instances quoted illustrate the phenomena of the protoplasmic cell, which is the basis of the physical life in animals. But there are other wonders. It is precisely the same in the vegetable kingdom. The President proceeds to give a number of examples to show that the primary cell in plants is identical with that in animals, and undistinguishable from it. "The spores which swim about in the field of the microscope, driven by vibrating cilia, and avoiding collision with obstacles in their way, behave exactly like the amœba." Dr. Fraser may tell you that this motion and careful avoidance of obstacles is due to

their magnetism and polarity. "But the most curious illustration of the identity of the elementary life in plants and animals, is found in the fact that the former as well as the latter are subject to the influence of anæsthetics. A sensitive plant confined under a bell-glass, with a sponge filled with ether, soon ceases to manifest any sensibility. Withdraw the sponge, and it will speedily recover germination. Fermentation may be arrested by the same means. Seeds of cress kept under the influence of ether for five or six days, remained quite passive. But they were only *sleeping*, and not killed. As soon as the ether was removed, germination set in at once with activity. The same thing is true of fermentation." It was stated as the results of all these investigations, "that in protoplasm we find the only form of matter in which life can manifest itself, and that though the outer conditions of life — heat, air, water, food — may be all present, protoplasm would be still needed, in order that their conditions may be utilized. It would, however, be a mistake to suppose that all protoplasm is identical. Of two particles of protoplasm, between which we may defy all the power of the microscope, all the resources of the laboratory to detect a difference, one can develop only to a jelly-fish, the other only to a man, and one conclusion alone is here possible,—that deep within them there must be a fundamental difference which thus determines their inevitable destiny, but of which we know nothing, and can assert nothing beyond the statement that it must depend upon their hidden molecular constitution."

And here I would venture a crude idea—that if protoplasm as revealed by the microscope, is really the beginning of life, its ultimate development may depend, less upon a hidden molecular constitution in the cell units, in which no differences can be discovered, than upon cell aggregation. Or, is it produced according to Dr. Fraser's theory, by the atoms assuming polarity, being vivified by magnetic action. The last would not be spontaneous generation, but something analogous. Really, all we know is, that like in the animal and vegetable proceeds from like. But it is an important admission by Dr. Allman, to which I would join the idea just expressed, "that his assertion does not in the least diminish the vast difference which separates lifeless from living matter, nor lessen the mystery of life itself. No chemist has yet built up one particle of living matter out of lifeless elements." Or, as I understand it, no chemist, or magnetist, or electrician, has yet made a *protoplasm*, or brought together atomic conditions necessary to create unicellular existence, much less to endow

"*an aggregate*" of cells with the direction of a positive animal life—a reason for which I think is satisfactorily given in the Book of Genesis, chap. 3, v. 22 to 24.

The foregoing are *a few short extracts* from the President's address, interspersed here and there with some passing observations; for I have felt, in the relation, that I may not only be too diffusive, but that I am trenching somewhat on the province of our talented associate and microscopist, Dr. Sommers. I have only further to hope that our Institute will soon possess microscopic instruments of sufficient power to enable *him* to show us all those microscopic experiments and microscopic life, the wonders of which have been for some time known to the scientists of other countries. From these anticipated resources we may, I think, reasonably expect, that in this to us new field of investigation, discoveries will be made that will prove our high estimation of this valuable branch of Natural Science, and perhaps enable us, in an hitherto untried zone of research, to contribute a little to what has been already realized.

Yet, after all the wealth of scientific discovery of our day, and our pride in it, which sometimes amounts to inflation, I think it must be conceded by sober reason that human progress, great as it is, has reached no further than the threshold of the temple of science, the golden pinnacles of which seem now and then to greet our vision high above the clouds of obscurity. The motto of its votaries must still be "Excelsior!" Still it is not as in the past ages, that speculative science, assuming the general ignorance, stands for truth, or is received without strict examination. The world has had much to unlearn of what had been for long periods received as indisputable. The earth, without further controversy, rolls round the sun, and is no longer a flat surface girdled by an unknown ocean. Even within a century revealed religion has been placed, I think, upon a surer basis by scientific interpretation. Geology, with yet much to unfold, so far shows us that the world (I say it with reverence) was not made in six natural days, although the sequence of creation corresponds more exactly with a reasonable and no doubt a more correct interpretation of the Divine record; and crude deductions with respect to the effects of the Noachian deluge, are fast giving way before investigations which, without ignoring that great event, or any of its phenomena, reasonably attribute much that was presupposed to belong to it, to other and remoter causes. These truths are intimately connected with and lie at the foundation of many of the grand discoveries of the age. Some of them are dogmas

now, and all will be so with succeeding generations. The difficulty with them is the self-sufficiency and scepticism they engender, and to restrain their assertion within the bounds of propriety. Science and religion ought to dwell in perfect harmony. True science can do no more than accommodate each to each by the operation of the laws of eternal truth. This is being done gradually but surely. If some of the most celebrated searchers into nature of our own day could wake up a century hence, they would without doubt be as much astonished at the stride of knowledge meanwhile, and the consequent disturbance of previous belief, as those would be who have lived a century before our era, could they now start into living consciousness of the past and present.

It may excite a smile that I should imagine so curious an event; but we may still consider it certain, that a comparison of notes would realize to all their minds the practical truth enunciated by one of the wisest among them, as true as when it was uttered, as to all that has been done, to wit: that we are only as children picking up pebbles from the shore, while the great ocean of truth lies unexplored before us.

But it is time that I should come nigher home. In Nova Scotia, within ten days' distance by steam of the mother country, and adjoining the great republic,—where we have unsurpassed facilities for acquiring a knowledge of and utilizing the latest scientific progress and discoveries,—it might be supposed that we would be practically acquainted with and profit by them, and with everything recognized as improvement. The necessity, however, is conceded but slowly, and we have not much to boast of in this respect. Our scientific pursuits are nearly all limited to a college curriculum,—to a course of chemistry, electricity, botany, and cognate sciences. This is doubtless an excellent preparation, but as yet, so far as we know, no further fruits have been produced. It is a college education — nothing more. There may be various reasons for this. Nova Scotia, though early settled, has never been very well known in the world, especially in the world of science. Capital and enterprise have not been largely employed to call her material resources (not to mention those which are inert) into active operation. She has looked to other means of wealth which were more readily procurable, but which, whatever they may have been, are not now steadily profitable. She is, in fact, so far as science is concerned, much behind the age. The urgency is, however, being rapidly forced upon her, that resources but partially used, or not used at all,

must soon be called into action, if we would play our part as an integral portion of British America. There is enough of talent and ability amongst ourselves to take secondary action in their development, although neither speculation nor capital at present appears very eager to make them available. It certainly does seem strange, that we cannot even point to the existence of a cotton-mill, with a chief city which is the Atlantic entrepot of a Dominion stretching from Halifax to the shores of the Pacific, possessing as we do railway communication for a long distance inland, and, as we shall do in a few years, from hence to British Columbia, to say nothing of the limitless coal and iron in Nova Scotia, and a cotton-growing country within twenty days' sail of our chief port. A reason may be found on the part of our own people in the want of capital for so expensive and important an undertaking, and ignorance of its management. But that our unsurpassed geographical position, and the acknowledged decadence of British manufactures, through rivalry of foreigners, should not have turned the attention of the cotton lords of England to Nova Scotia, from whence to supply the growing Dominion, and to carry the war into the enemy's territory, is something not easily understood. I may be pardoned this allusion. It is not so far beyond the domain of natural science, involving as it does many of its branches, that our wishes and hopes may not centre in such an enterprise.

Of our other industries connected with natural science, I will speak briefly. Coal is inexhaustible, and I hope to see the day when cotton and sugar and iron, and other manufactories at home, shall preclude the necessity of looking for a market abroad for this valuable mineral; and when our own Dominion, the western part of it especially, shall be more ready to buy from us than we to sell to them. This is the true solution of the problem of coal mining as a source of national wealth. The time will surely arrive, and we hope is not far distant, whoever may live to witness it. Strange that even now our interests should be diverse, or not to be reconciled, and that we cannot work together as an united people.

Iron is as inexhaustible as coal, and more valuable. One blast furnace is at work for the reduction of its ores, requiring scientific knowledge and practical industry and economy to sustain it, and these will no doubt multiply as markets are realized and demand increases.

The rocks of the Atlantic coast line, from Canso to Yarmouth, and for a considerable breadth inland, are prolific in gold, which,

even now, is worked profitably, and would be much more so if science and capital were largely employed in its development.

Promising indications of Copper are frequent, even within a short distance of the capital, but they have not tempted eager speculation or scientific research. Copper, which requires patient and expensive exploration, is as yet only talked about as a Provincial enterprise. The same may be said of Silver and Lead, which are believed to exist in workable quantities, only awaiting capital and skill, as employed in other countries, to make them largely profitable.

It is high time that we knew the extent of our natural resources. I would like to be able to state that an exhaustive geological survey of the Province had been made, and its mineral riches mapped with some degree of certainty. We should know by this time if they are as valuable as they have been assumed to be, or otherwise. All doubt upon this subject ought long since to have been set at rest. The geological survey of Canada, provided for by the Dominion Government, began at the wrong end.

It will be expected, I presume, that I should, before I conclude, make some reference to the work of the Institute during the past year. I shall do so as shortly as possible. I make no comparisons, and do not claim for it any great originality, or superlative merit. It is but an humble follower in the wake of more richly freighted argosies. I shall merely assert, therefore, that it has furnished a large amount of information on the geology, mineralogy, zoology, botany and meteorology of Nova Scotia, which otherwise would not have been generally known. In that branch of science first mentioned I will take the liberty to allude to the articles of the Rev. Dr. Honeyman, which of late have been directed to a correction of the geology of our own Province. On the evidence of position and palæontology, strata which previously were supposed to be widely extended, are proved not to exist, or to belong to lower formations. I recommend these papers, which will be found in our published Transactions, to the careful attention of all acquainted with the science, who take an interest, for economic purposes or otherwise, in the succession and deposition of the rocks, as a guide to the mineral resources of Nova Scotia. A careful study of them may prevent many mistakes of scientific importance. The department of geology, I regret to say, was badly represented at the Provincial exhibition; but even there was some encouragement, and those who sought might have found very fine specimens of coal from the

Little Glace Bay, Pictou, and other mines; gold specimens from Oldham and Montague, and from the latter, within a distance of eight miles from Halifax, a brick (so called) of gold, a month's work of fourteen men, valued at $7,666.92, taken from the "Rose" lode. Also sulphuret of and native copper, and galena and silver,—with some fine specimens of granite and syenite, freestone and other rocks and minerals, awaiting science, industry and capital for their complete development.

In like manner I desire to draw attention to the papers of my friend, Dr. J. Bernard Gilpin (now absent), on the Zoology of Nova Scotia. Dr. Gilpin has successively drawn upon the mammals of Nova Scotia (Indians included) for description, until he has left none remaining the history of which he has not noted. It is almost the same with the fishes that frequent or are native of our coast and inland waters. In a recent No. of the Transactions he shows us the salmon "from his first appearance as a minnow, and through all his changes, until lastly he gives us a drawing of his degeneration (degradation I should call it) in colour and leanness, and the almost grotesque changes in the jaws of the male during spawning. He is also of opinion, against preconceived belief, (in which he is supported by Mr. Wilmot, of the fish-breeding establishment at Bedford,) that all our salmon are retained during the winter in our lakes and inland waters.

J. Matthew Jones, F. L. S., formerly President of the Institute, to whom we are much indebted for papers on various subjects, has contributed, in an Appendix to the Transactions of 1879, a list of the Fishes of Nova Scotia, corrected to date, in the preparation of which he manifests great research, and acknowledges the generous assistance of his much esteemed friend, Prof. G. Brown Goode, of the Smithsonian Institute, Asst. United States Fish Commissioner. This paper will be much valued for the information given, and for future reference.

Dr. Sommers, Prof. of Microscopy, and the Rev. E. Ball, of Maccan, furnish botanical papers of merit and usefulness—the former on Nova Scotian Mosses, the last named gentleman on Aspidium Spinulosum—*Grey*. Dr. Sommers has also furnished a paper on Microscopy.

Mr. H. Louis, Assoc. Roy. School of Mines, (a recent member of our Institute,) communicates a paper on "The Analysis of a New Mineral from Blomidon." For this contribution to science, with reference to which Prof. Dana, to whom it was submitted, remarks that there is nothing like it in Mineralogy, (meaning

that it is an original discovery,) Dr. Honeyman has suggested the name of "Louisite," by which it will henceforth be known. Also, a valuable paper "On the Ankerite Veins of Londonderry, Nova Scotia," with copious analyses. This gentleman, from whose talent much was expected, on behalf of the Institute, and the country especially, has left our shores to fill a more responsible situation in England.

"The Limonite and Limestones of Pictou County," is the title of a paper bearing upon the economic mineral resources of Nova Scotia, by Edwin Gilpin, A.M., F. G. S. The processes of nature, by which these minerals were formed, are lucidly accounted for and described, and their value shown to be considerable. According to the author they appear to occupy positions similar to the marine limestones at Whitehaven, and Furness, and the Mendip Hills, in England,—and are, by some, considered to have been deposited in a similar manner to the large deposits of Limonite, the lower silurian calciferous formation in Pennsylvania. The limestones of Artzberg and the Thuringian Forest are believed to have been formed in the same way.

Mr. Dewar has a paper on his favorite subject of Ato-magnetism—which I have previously noticed in connection with the spectrum discoveries of Prof. Lockyer, and the article in the *Medical Tribune.*

Mr. Mellish, a secretary of the Institute, placed on record at the close of last session, an interesting description of fish culture in Nova Scotia, stating that a total of 4,800,000 salmon had been distributed from the hatchery of Bedford Basin during the short space of four years.

On other matters concerning the Institute and its working, I shall be very brief. We have friendly correspondence with many sister societies in various parts of the world. The Royal Microscopical Society of London, recently passed a resolution, which recognizes for your President, for the time being, the honour of appending F.R.M.S. (Fellow of the Royal Microscopical Society) to his name, of which honour, however unworthy, your humble servant has been the first recipient. This recognition of the Institute is of some value, and has been suitably acknowledged; and I hope before long we shall be able to show, by practical illustration, that it is not undeserved. We exchange our Transactions with the valuable monthly publications of the R. M. S.

Best of all, perhaps, is the statement I am able to make—that we owe no man anything.

I would fain have closed with this gratifying announcement;

but a sorrowful task still awaits me, viz., to notice that, during the past year, we have had to lament the decease of three of our most zealous and useful members, and very good friends. You will find obituary notices of them in the published Transactions. It is again a painful duty imposed upon me to mention a fourth bereavement in the death of Dr. How, Professor of Chemistry, King's College, Windsor (not latterly a member of our Institute, but a frequent contributor to its Transactions), which took place at Windsor on the 27th September last. Dr. How was an able scientist, and had made some interesting mineralogical discoveries in Nova Scotia. He filled the professorial chair with credit to himself and the University, and with much advantage to the students, by whom he will be long remembered, and his death regretted. His loss must be deeply felt by the Institution at Windsor, which he adorned by his talents and amenities; and it will not be easy to fill a chair, the duties of which require in an eminent degree high qualifications and systematic order.

I have now, amid avocations which leave me little leisure for work like this, endeavored (imperfectly enough, I know) to perform a duty prescribed by the rules of the Institute. I fear I have wearied you with an address which, like many others of the kind, on similar occasions, has not the merit of propounding startling hypotheses or original theories. It may, however, serve to show that we are in earnest, and if it has the slightest effect in stimulating pursuits and studies within our reach, it will fulfil my highest expectations. I would have liked to be able to tell you that our people take as much interest in natural science — comparatively, of course — as the people of England do in the work of the British Association, or that the knowledge of Nova Scotia we have conveyed, which is by no means unimportant, is as highly appreciated among ourselves in this our own home, as it seems to be in other countries. This desire, however, is premature, and many of us may not await the better time coming. Instead, we must, I suppose, rest content with being the pioneers of science in Nova Scotia, and leave it to future generations to enter into and profit by our gratuitous and disinterested labors.

PROCEEDINGS

OF THE

Nova Scotian Institute of Natural Science.

VOL. V. PART 2.

Dalhousie College, Oct. 8, 1879.

ANNIVERSARY MEETING.

WILLIAM GOSSIP, ESQ., *President, in the Chair.*

Inter alia.

The following Gentlemen were elected Office-bearers and Council for the ensuing year:—

President—WILLIAM GOSSIP.

Vice-Presidents — Prof. JOHN SOMMERS, M. D., Prof. GEORGE LAWSON, PH.D., LL.D.

Treasurer—W. C. SILVER.

Secretaries—REV. DR. HONEYMAN, and JOHN T. MELLISH.

Council—DR. GILPIN, HON. L. G. POWER, J. M. JONES, ROBERT MORROW, ANDREW DEWAR, AUGUSTUS ALLISON, ALEX. MCKAY, W. S. STIRLING.

On motion the PRESIDENT was requested to deliver an Address at the next meeting of the Institute.

ORDINARY MEETING, Dalhousie College, Nov. 10, 1879.

THE PRESIDENT *in the Chair.*

A larger, than usual, number of persons were present. Among them were His Honor the LIEUTENANT-GOVERNOR, MISS ARCHIBALD, and COL. STEWART, aidecamp.

The PRESIDENT delivered a lengthy and interesting Address, which will be found in the *Transactions.*

Mr. MORROW drew attention to an error in the published *Transactions* of 1878-1879. Appendix, page 94, Mr. JONES states that Mr. R. MORROW informs him that "Scomberesox Storeri"—bill fish—is seen on the coast of Cape Breton during the month of August. Mr. MORROW stated that he had seen them in Pictou Harbor.

DR. HONEYMAN, the *Secretary*, gave a popular and interesting description of the Geology of Annapolis County, especially that of the Moose River Iron

Deposits. This was the substance of a paper which will also be found in the *Transactions.*

His Honor the LIEUTENANT GOVERNOR then made some complimentary observations on the Addresses delivered, and referred to the valuable work of the Institute, as illustrated by its Volumes of Proceedings and Transactions published. By means of its publications the Institute has been instrumental in disseminating reliable information on the Natural History of Nova Scotia in all its branches. He had just been enabled to meet the demands of Kew Gardens for information regarding the Botany of the Province, by the gift of a series of Papers published in the *Transactions.*

ORDINARY MEETING, Dalhousie College, Dec. 8, 1879.
The PRESIDENT *in the Chair.*
Inter alia.

DR. J. BERNARD GILPIN made some observations on specimens of supposed rude pottery found in and around Grand Lake. The specimens belong to the Provincial Museum. Their forms are so singular as to occasion a diversity of opinion regarding their character and origin. Dr. HONEYMAN, who furnished the specimens, has no doubt whatever that they were made by man, and that they are prehistoric remains. Some of them are of regular and rather elegant shape. The basis on which they have been formed are stones—quartzite or argillite. The other material seems to have been constructed by successive layers of clay (?) so that the interior of the articles have a concentric appearance—the outside is somewhat smooth. They are somewhat firm when wet, when dry they are very fragile. When the Lake has the water at the usual height they are said to be seen lying at a depth of six feet or more. Some consider them to be concretionary, or natural forms. The stony nucleus or basis is always exposed; when the form is saucer shaped it constitutes the bottom. Their mode of occurrence and other matters will be fully investigated in the next dry and favorable season.

DR. GILPIN also exhibited a drawing of an unknown mammal. It was supposed to be an *albino* dormouse. It was found at Annapolis last summer.

DR. LAWSON gave an interesting account of his investigation of a very thick deposit of diatomaceous clay found in the Lakes of Halifax Water Works. He illustrated the character of diatom structure and mode of growth on the blackboard, and by the microscope.

He also exhibited specimens of Cotton, Rice, and Palmetto which had been brought lately from the Southern States by MR. ANDREW JACK.

It was announced that Prof. DEMILLE and W. H. NEAL had been elected members.

ORDINARY MEETING, Dalhousie College, Jan. 26, 1880.
The PRESIDENT *in the Chair.*
Inter alia.

DR. GILPIN exhibited the Cub of a Bear, which was regarded as of peculiar interest. An account of it will be found in the *Transactions.*

Prof. LAWSON was then called on by the President to read his Paper "On Native Species of Viola of Nova Scotia."

The Paper was lengthy and interesting. It was well illustrated by means of the blackboard, and numerous dried specimens of the Viola. A conversation followed the reading of the Paper.

DR. SOMMERS also gave the substance of a Paper "On Nova Scotian Fungi." This Paper was illustrated by dried specimens.

A discussion followed.

ORDINARY MEETING, Dalhousie College, Feb. 9, 1880.

The PRESIDENT *in the Chair.*

Inter alia.

The PRESIDENT alluded to the death of Prof. DEMILLE, who had recently been elected a member of the Institute. He said :—

" I deem it a duty, melancholy though it be, to announce to you that by the recent decease of PROF. DEMILLE, after a short illness, the Institute has been deprived of another of its members, one of whom it may be truly said, that his loss will be deeply felt, not only by the Institutions of learning and Science with which he was connected, but generally by the community in which he lived. It is but little to say of Prof. DEMILLE that wherever he was known he was esteemed and respected. As an author he ranked high, and his works are very popular in the neighboring Republic, where perhaps they are better known than amongst ourselves—his Rhetoric has become a text book in several universities. Although PROF. DEMILLE'S more intimate connection with our Institute had been somewhat recent, I have good reason for believing that he took much interest in its proceedings, and that he attended its meetings as often as his more pressing avocations permitted ; and had he been spared I have no doubt whatever that his talents would have been freely exerted in its service. As it is there is only left to us to acknowledge, with humility, an afflictive dispensation which might not be averted by human wisdom ; and to add to the general expression our sympathy with his family in their bereavement."

It was resolved that this tribute to the memory of the deceased be inserted in the Records of the Institute.

DR. SOMMERS gave a minute and interesting account of the Anatomy of a Seal from the Magdalen Islands.

DR. HONEYMAN then read some remarks on the Geology of the Magdalen Islands, suggested by specimens of Rocks and Minerals presented to the Provincial Museum.

Mr. FOX, who had resided on those Islands for twenty years as Collector of Customs, gave interesting information relating to the inhabitants and products.

ORDINARY MEETING, Provincial Museum, March 15, 1880.

ROBERT MORROW, ESQ., *in the Chair.*

Inter alia.

Specimens of the Corals, *primnoa reseda*, and *Paragorgea Arborea* were exhibited from the Museum collections. These had been found by fishermen in the Halibut fishery at Little Banquereau, north of Sable Island. They were regarded with peculiar interest as being Nova Scotian products.

DR. GILPIN then read a long and interesting Paper, "On the Wild Ducks of Nova Scotia."

The Paper was illustrated by the extensive and beautiful collection of Wild Ducks in the Museum.

ORDINARY MEETING, Dalhousie College, April 19, 1880.

The PRESIDENT *in the Chair.*

DR. SOMMERS read some remarks " On a new Nova Scotia Trillium."

The specimen was found by Miss Godfrey, of Clementsport, Annapolis County, near the Victoria Bridge, Bear River.

MR. MORROW then read the first part of an interesting Paper " On the Osteology of *Salmo Salar.*"

The Paper was illustrated by carefully prepared skeletons.

ORDINARY MEETING, Dalhousie College, May 10, 1880.

The PRESIDENT *in the Chair.*

Inter alia.

DR. JAMES WALKER was elected an Associate member.

MR. MORROW read the second part of his Paper " On the Osteology of the *Salmo Salar.*"

DR. HONEYMAN then read a Paper entitled " Notes on a new Geological Progress Map of Pictou County."

Adjourned until October next.

LIST OF MEMBERS.

Date of Admission.			
1873.	Jan.	11.	Akins, T. B., D. C. L., Halifax.
69.	Feb.	15.	Allison Augustus, Halifax.
77.	Dec.	10.	Bayne, Herbert E, Ph.D., Professor of Chemistry, Royal Military College, Kingston.
64.	April	3.	Bell, Joseph, High Sheriff, Halifax.
64.	Nov.	7.	Brown, C. E. Halifax.
78.	Nov.	11.	Cockburn, Col., R. A.
67.	Sept.	10.	Cogswell, A. C., D. D. S., Halifax.
72.	April	12.	Costley, John, Dep. Pro. Secretary, Halifax.
63.	May.	13.	Cramp, Rev. Dr., Wolfville.
75.	Jan.	11.	Dewar, Andrew, Architect, Halifax.
63.	Oct.	26.	DeWolfe, James R., M. D., L. R. C. S. E.
63.	Dec.	7.	Downs, Andw., Corr. Memb. Z. S., London, Halifax.
71.	Nov.	29.	Egan, T. J., Taxidermist, Halifax.
74.	April	13.	Forbes, John, Manager of Starr Works, Dartmouth.
72.	Feb.	12.	Foster, James, Barrister-at-Law, Dartmouth,
63.	Jan.	5.	Fraser, R. G., Chemist, Halifax.
73.	April	11.	Gilpin, Edwin, F. G. S., Inspector of Mines, Halifax.
60.	Jan.	5.	Gilpin, J. Bernard, M. D., M. R. C. S., Halifax
63.	Feb.	2.	Gossip, Wm, F. R. M. S., *President*, Halifax.
63.	Jan.	16.	Haliburton, R. G., Barrister-at-Law, Halifax.
78.	Dec.	9.	Harris, V. E. Rev., Land and Mines.
63.	June	17.	Hill, Hon. P. C., Barrister-at-Law, Halifax.
66.	Dec.	3.	Honeyman, Rev. David, D. C. L., *Secretary*, Professor of Geology, Dalhousie College, Halifax.
74.	Dec.	10.	Jack, Peter, Cashier of People's Bank, Halifax.
79.	Jan.	11.	James, Alex., Judge of Supreme Court, Halifax.
63.	Jan.	5.	Jones, J. M., F. L. S., Halifax.
66.	Feb.	1.	Kelly, John, Dep, Chief Com. Mines, Halifax.
77.	Nov.	19.	King, Major, R. A., Halifax.
64.	Mar.	7.	Lawson George, Ph.D., LL.D., Professor of Chemistry and Natural History, Dalhousie College, *Vice-President*, Halifax.
75.	Jan.	11.	Mellish, John T., M. A., *Secretary*, Halifax.
72.	Feb.	5.	McKay, Alex., Principal of Schools, Dartmouth.
77.	Jan.	13.	Morrow, Geoffrey, Halifax.
66.	Feb.	3.	Morrow, James B., Halifax.
72.	Feb.	13.	Morrow, Robert, Halifax.
70.	Jan.	10.	Murphy, Martin, C. E., Provincial Engineer, Halifax.

Date of Admission.			
1865.	Aug.	29.	Nova Scotia, the Rt, Rev. Hibbert Binney, *Lord Bishop of*
72.	Nov.	11.	Poole, H. S., F. G. S., Superintendent Acadian Mines, Pictou.
76.	Jan.	20.	Power, Hon. L. G., Senator.
71.	Nov.	19.	Reid, A. P., M. D., Superintendent of Lunatic Asylum, Dartmouth.
66.	Jan.	8.	Rutherford, John, M. E., Halifax.
64.	May	7.	Silver, W. C., *Treasurer*, Hollis street, Halifax.
68.	Nov.	25.	Sinclair, John A., Halifax.
80.	April	12.	Neal, W. H., Halifax.
75.	Jan.	11.	Sommers, John, M. D., Professor of Physiology and Zoology, Medical College, *Vice-President*, Halifax.
74.	April	11.	Stirling, W. Sawers, Cashier of Union Bank, Halifax.
79.	Feb.	10.	Twining, Chas. R., C. E., Halifax.
66.	Mar.	18.	Young, Sir William, Knight, Chief Justice of Nova Scotia, Halifax.
77.	Jan.	13.	McGregor, J. G., A. M. D. Sc., Bristol, England, Professor of Physics, Dalhousie College, Halifax.

ASSOCIATE MEMBERS.

1863.	Oct.	6.	Ambrose, Rev. John, A. M., Digby.
77.	May	14.	Burwash, Rev. Prof., Wesleyan College, Sackville, N. B.
75.	Nov.	9.	Kennedy, Professor, Acadia College, Wolfville.
78.	Feb.	11.	Louis, Henry, Assoc. R. Sch. of Mines, London.
75.	Jan.	11.	McKay, A. H., A. M. B. Sc., Principal of Pictou Academy.
75.	Nov.	9.	McKinnon, Rev. John, P. E. Island.
65.	Dec.	8.	Morton, Rev. John, Trinidad.
76.	Mar.	13.	Patterson, Rev. George, D. D., New Glasgow.
80.	May	10.	Walker, Jas., M. D., St. John, N. B.

CORRESPONDING MEMBERS.

71.	Nov.	29.	Ball, Rev. E., Maccan.
68.	Nov.	25.	Bethune, Rev. J. S., Ontario.
71.	Nov.	1.	Cope, Rev. J. C., President of the New Orleans Academy of Science.
70.	Oct.	27.	Harvey, Rev. Moses, St John's, Nfld.
71.	Nov.	1.	King, Dr. V. C., Vice-President of the New Orleans Academy of Science.
71.	Oct.	11.	Marcou, Jules, Cambridge.
71.	Jan.	10.	Matthew, G. M., St. John, N. B.
72.	Feb.	5.	Tennant, Prof. J., F. G. S., F. Z. S., &c., London, Mineralogist to H. M. the Queen and the Baroness Burdett Coutts.
77.	May	14.	Weston, I. C., Geological Survey of Canada.

LIFE MEMBER.

Hon. Dr. Parker, M. L. C., Nova Scotia.

TRANSACTIONS

OF THE

Nova Scotian Institute of Natural Science.

ART. I.—NOVA SCOTIAN GEOLOGY—ANNAPOLIS COUNTY continued.—BY THE REV. D. HONEYMAN, D. C. L., *Curator of the Provincial Museum and Professor of Geology in Dalhousie College and University.*

(*Read Nov.* 10, 1870.)

INTRODUCTION.

ABOUT the middle of July last I resumed my investigations in the Geology of Annapolis county. My main object, however, was the investigation of the geological relations of the Iron deposits of Moose river. They have already been connected and correlated with the Iron deposits of Nictaux. Both have been assigned to the Devonian period.

I have in a preceding paper referred the Nictaux deposits to the Middle Silurian age (*Transactions, 1877-8*), and for the time in a manner separated them from the Iron deposits of Moose river. I was prepared, however, for a reunion of both. The fact that the gigantic trilobite, *Asaphus ditmarsiæ*, was found in the magnetite of Moose river had led to the belief that it too was of Middle or possible Lower Silurian age.

DIARY.

Tuesday, 15th.—On my way to Moose river I observed granites to the south of the Lawrencetown Railway station. This is almost due north of the approximate western limit of the Nictaux Iron bearing strata. From Lawrencetown onward to Annapolis the only rocks observed outcropping are granites.

I had an opportunity of observing the granites to a distance

four miles south of Annapolis Royal. Through the kindness of one of Dr. Gilpin's friends we had a delightful carriage ride into the South Mountain. Reaching, apparently, the highest elevation on turning, the panorama beheld, on the north, was enchanting and extensive. The granite is known to extend 50 miles south of Annapolis. Dr. Gilpin has observed it thus far, and he believes that it connects with the Granites of Shelburne, on the Atlantic coast. This is important testimony, in its relation to the identity and age of the Annapolis and Shelburne Granites, as well as those of Halifax and other localities on the Atlantic Coast.

I found also a kind invitation awaiting me, from the Rev. Mr. Godfrey, of Clementsport, through his brother-in-law, Dr. Gilpin, offering me the hospitalities of the "Rectory." This was found to include very efficient assistance in the prosecution of my most important investigations. I have also to acknowledge my obligations to Mr. Church, for a copy of his excellent map of Annapolis county, plain and unvarnished. This was of very great assistance in prosecuting and locating my work.

Wednesday, 16th, Dr. Gilpin took me to Moose River, by the South Mountain Road, a very rough, but admirable geological road. Here I had an opportunity of observing the transition from the Granites to the stratified rocks, containing the Moose River Iron ores. We passed from the one into the other, about Beiler's Lake (Church's Map). The transition did not appear in outcrops, but from the contour, and the change from granite boulders, *debris* and roughness, to slaty, clayey and soft roads.

There were occasional outcrops of stratified rocks seen, before reaching the "New Mines" of Moose River ("Iron quarry" of Church's Map).

At the New Mines were observed considerable excavations, all perfectly dry and fresh in appearance. Great piles of slaty material with *Magnetite*, were exposed, so as to be satisfactorily examined. Several hours were spent collecting specimens of fossils. Dr. Gilpin showed me the *situs* of the *Asaphus ditmarsiæ*, as indicated to him by the superintendent of the mines. The rock and the matrix of the *Asaphus* correspond, both being largely composed of *magnetite*.

We afterwards proceeded through the Valley of Moose River, observing numerous outcrops of rocks on the road side and in the river, and at length reached Clementsport, at the mouth of the river. I received a hearty welcome from the worthy Rector and his family. It surprised me agreeably to find, that my head quarters were beside the Iron works, and consequently convenient for work.

The same evening I went to call upon Mr. Ditmars, the collector of H. M. customs, and of geological and other interesting curiosities. As I expected of a collection, of which the *Asaphus ditmarsiæ* was once a specimen, other objects interesting to the geologist formed a part, one of these was a large piece of *quartzite*, with a singular *cruciform* and other organisms. Mr. Ditmars kindly presented this very interesting specimen to the Provincial Museum. I shall yet refer to it in the sequel.

I was then taken to see the "Ditmars Falls." Here was observed, a fine exposure of metamorphic rocks and a really picturesque water fall. When the brook is well supplied with water, they are said to be somewhat imposing.

Thursday, 17th, the morning.—Examined the ruinous Iron works and the interesting section of rocks adjoining. The date of the erection of the Furnace, as seen from the keystone of an arch, was "A. D. 1831." The most extensive and useful part of the works that survives is the great dam and viaduct.

Forenoon.—Went with Mr. Godfrey to the "Old Iron Mines," at Milner's, (Church's map), traversed the same road which Dr. Gilpin and I travelled on the day before, a length of three miles. I examined the numerous outcrops of rocks, which I had already noticed in passing. Turning to the right we travelled upwards of a mile, crossing the extension of the Iron bearing rocks of the New Mines, without observing any outcrop of rocks. Turning again to the right, we travelled the Hessian Line road about three-quarters of a mile. We then walked in a northerly direction about a quarter of a mile, and reached the Old or Milner Mine.

No rocks were observed *in situ* from the time we left the Moose river road until we came to the Mines I examined the

old trenches, which are two in number, running parallel on two *beds* of ore, twenty feet apart.

These have the same course as the trench of the New Mines, and are one or other doubtless a continuation of the Iron bearing strata of the latter. Fossils were collected, of forms similar to those of the *Asaphus ditmarsiæ strata*, and others not found there. Returning we kept on the Hessian Line road until we reached the Moose river road, by which Dr. Gilpin and I came to the New Mine. I had thus an opportunity of examining the other outcrop already referred to, also of re-examining the New Mine and of adding to my collection of fossils. I thus found the Moose river road presenting a good cross section of the greater part of the rocks of the area under examination.

Friday, 18th, Morning.—Engaged in locating on Church's map, the positions of the several outcrops examined, and in studying their relations.

Forenoon.—We went to Bear River Village, travelling the Digby Road at a distance of two and half miles, *Strata, deep* red and *soft* of considerable thickness, were observed and examined in "Deep Brook." Half a mile farther, on the left, we came to the Bear River Road, at the Temperance Hall and School House. Proceeding along this road we found an interesting outcrop of rocks; just before reaching the summit of the mountain (Purdy's) other outcrops were observed, especially after reaching the road which follows the course of Bear River on the east. Outcrops were observed occurring very frequently between the cross roads and the village. Still keeping on the east side of Bear River, a short distance above the bridge, I found and examined an interesting outcrop of rocks, on the river side. The rocks are black slate with limestones, much metamorphosed and very hard. This is particularly the case with the limestones, which are fossiliferous. I could only get fossils out of them, where they were weathered, I collected some at the southern side of the outcrop, consequently in the lower *strata*. On the Digby county side of the river, the same *strata* are seen outcropping in a shipyard where a large ship was being built. Farther up the river we crossed at the bridge at Rice's mill; here we found a splendid

outcrop of rocks, which at first sight seemed gneissoid, on closer examination they were found to be highly fossiliferous. I collected a few fossils and traced the outcrop southwards, until the rocks became obscure. Beyond, heights were observed with large granite boulders. In the village, on the Digby side, north of the bridge and below the wharves, another important outcrop of rocks was examined, on the road and river side. Returned to Clementsport by the way we came.

Saturday, 19th.—Examined an interesting outcrop of strata, at and north of the wharf, on the shore of Clementsport and opposite the Iron works: afterwards walked along the Moose river road to the New Mine, examining in succession and detail the outcrops of rocks already noticed, with a view to the proper understanding of the geology of the district.

Sabbath, 20th.—Attended service in Mr. Godfrey's churches, at Clementsport and Bear river village; went to Digby in the evening; attended services at Mr. Ambrose's.

Monday, 21st.—We travelled the road to Waldee, which branches from Moose river road about half a mile from Clementsport; observed several outcrops of rocks similar to those exposed on the Moose river road, and examined the strata exposed in a deep brook at Waldee ; proceeded to the mouth of Bear river and Digby road by the old post road, on which were observed interesting outcrops of rocks. Returned to Clementsport by the Digby road.

Tuesday, 22nd—We returned to Bear river for the purpose of examining certain rocks exposed in a brook and on the river side, about half way between Bear river village and the Victoria bridge; observed strata between the cross roads already referred to (Friday, 19th), and the rocks of which we were in quest We found the rocks in the brook, somewhat obscured by *debris*, but collected fossils. On the side of the river we examined a fine clear section of the same rocks; collected fossils, and also observed the rocks underlying. We returned by the road we came.

Wednesday, 23rd.—In the morning I went to the point, east side of Clementsport, with the expectation of finding *strata* ex-

posed at low water. I passed over the beach, teeming with life, searched for *strata* among luxuriant sea vegetation, and found only a great accumulation of rock masses and boulders, from the mountains on the north side of the basin (Annapolis). Under a pouring rain I made a collection of marine *fauna*, which lay in my way. I reached the rectory after a walk of a mile, wet enough. The rain was very much desiderated by the farmers, and upon the whole a rainy day was not very objectionable to myself. I had thus leisure to make up my notes, locate my work on the map, run my lines into, and even to forecast the geological arrangements of Digby county, especially on the coast of Saint Mary's bay, to await confirmation in another season.

Thursday, 24th.—I proceeded to revise and complete the Moose River section by making probable additions, whose existence was inferred from occurrences at Bear River, *i. e.*, I expected to find the extension at Moose River of the fossiliferous rocks, found above the Bear River Bridge and Rice's Mill.

Friday, 25th.—About a mile S. E. of the New Iron Mine we found a fine exposure of the rocks sought for. From this outcrop to a sawmill on the west branch of Moose River, 1¼ miles, nothing was to be seen but the *evidence of Granite.* i e. a change of *contour*, granite *debris* and boulders. Under the guidance of Mr. Godfrey, I believe that I have examined every important exposure of rocks in the district. The whole area traversed is 7x5½ miles=38 square miles. The greatest width of the strata examined seems to be from Digby to some point west of Bear River, along the line of strike of Bear River strata, being 5.5 miles. Along Bear River, the width is 4.3 miles; along Moose River and road extension, 4.3 miles (the measurements are according to Church's map).

PETRA.

1. *Granites.*—We have seen that the stratified rocks of the region are bounded on the east and south by granites. The granites are a continuation of those of Nictaux, and the same as to general character and age, i. e. in age they are Lower Cambrian with Lower Silurian alteration. Here they have not been observed in contact, or even in close proximity to the strata as at

Nictaux, consequently this element has not been available in the matter of mutual correlation.

2. *Gnessoid rocks.*—Dr. Gilpin informed me of the existence of gneissoid rocks in the Granite Mountain, south of Annapolis, not far from the point of Panorama, (Diary Tuesday). Since then he has given me specimens of the rocks referred to. They correspond with the gneissoid rocks at Nictaux and are doubtless of the same age, (Upper Cambrian). Masses and boulders of similar rocks were observed in the region of Moose River. Some of the masses looked as if they might be *in situ*, but they were evidently transported. It is possible that the rocks may intervene between the fossiliferous quartzites of the extreme south of Moose River section and the granites, without making their appearance by outcrops.

3. *Diorites.*—As at Nictaux these are of frequent occurrence. The greatest exposure of Diorite (1) is on the Digby side of the Bear River, (Victoria) Bridge. This may be regarded as the first of the Bear River section of rocks. Diorite (2) was observed on the Old Post Road near Bear River. (Diary, Monday,) Diorite (4) is near the summit of Purdy's Hill. (Diary, Tuesday,) Diorite (5) is on the Moose river road about a mile and a half from Clementsport. Diorite (6) is on the same road section about an eighth of a mile from the preceding. Diorite (7) is about a third of a mile from Diorite (6), and at the lower end of Bear River Village, (Diary, Thursday,) at a distance of about three and a half miles from Diorite (1), at Victoria bridge. It is not far below the extension of the strata of the New mines in the same locality. If this Diorite 7 were to be extended to Moose river its position in the section would not be far to the north of the New mine. If the others were in like manner to be extended, we should have Diorites occurring in the section the same number of times as in the Nictaux river and Cleveland mountain section.—*Vide Paper.*

4. *Quartzites and Sandstones.*—The Quartzite which seems to be *first* in order is exposed on the Annapolis side of Bear river, about one-eighth of a mile from Diorite [1] (Diary, 2nd Tuesday). Mr. Godfrey informed me that an attempt had been

made to improve the river road, which is certainly very steep where it passes over this quartzite and its associate rocks, but had to be abandoned on account of the hardness of the rocks. The outcrop on the river certainly indicates considerable thickness and flinty hardness. The *second* quartzite is exposed at T. Bogart's, in great masses on the east side of the road. The road makers seems to have shunned this. It is of equal hardness with the preceding. It occurs 1.1 miles from it. The *third* quartzite is at Rice's mill. This is fossiliferous (Diary, Thursday, 17th). It is more like a sandstone. It is metamorphic, but not in the same degree as the two preceding. It has cleavage but is of inferior hardness. Its extension is at Moose river, which is also fossiliferous (Diary, Thursday, 24th). This is highly metamorphic and of equal hardness with Quartzites (1 and 2).

5. *Micaceous Slate.*—A thick band of highly micaceous and black Slate succeeds the *first* diorite (3) of the Moose river road section. The outcrop of this is very striking. It looks like roofing slate and divides very regularly into rhomboidal forms. When split the surfaces are coated with scales of mica, giving an unctuous touch.

Another micaceous black slate was observed in connection with the great quartzite of Bear River.

These slates very much resemble the micaceous strata of Nictaux Falls, except in compactness. As this properly may be viewed as accidental, the resemblance may be regarded as indicating the co-temporarity of the Nictaux slates, which I was led to regard as of *age prior* to the strata with which they are associated. *Vide Paper in Transactions.*

STRATA.

Argillites.—In describing these I shall sketch the Moose River section.

1st.—We have the red and grey strata north of the wharf of Clementsport. The same appears in sections on the Digby side of Bear River, at the Victoria Bridge. This is above diorite, (1.) They are also seen in Deep Brook, at Ditmars farm, between Victoria Bridge and Clementsport. Here they extend from the post road to the beach of Annapolis basin. They

are all very red, so much so that when ground they may be used as *red ochre.* Part of the strata of light colour are said to act like soap when used in washing. The softness of the band and its position leads to the inference that it has suffered very much from denudation in previous periods as well as the present. It doubtless added its *quota* to the formation of the New Red Sandstone (Triassic). Its colour should be taken into account on speculations "On the colouring of the New Red Sandstone" of Annapolis and Kings Counties. I have already credited a part of this colouring to the *Red hematite* of Torbrook, Nictaux. The red slates of Kentville and Wolfville should not be overlooked. In the outcrop at Clementsport the red and grey argillites have interbedded quartzites and quartz veins, the latter attaining to a thickness of three inches. Following these are slates of various shades of grey and black, on them the wharf is built.

The next in order are the strata of the Iron works on the other (E.) side of the harbour. These extend as far as the Bridge according to the outcrops. They are highly metamorphic, having slaty cleavage joints. They are very hard, micaceous and crumpled. Their colours are grey and black.

Beyond the Bridge are the slaty strata of Ditmars's Falls (Diary Wednesday). On the road the outcrops of these are often bold cuttings. This is especially the case at the beginning of the road to Waldec. About a seventh of a mile beyond the Bridge a fine outcrop is seen in the river. They present a beautiful banded appearance, and are very hard. After this comes the micaceous slate, already described. Beyond these, after an obscure interval, we have the slates of the New Mines, also described. These extend to Milner's Mine, westward they outcrop on the Annapolis side of Bear River, and also on the Digby side above the Diorite. As the quartzite with fossils, at the end of the Moose River section, has been shewn to be the extension of the Fossiliferous sandstones at Rice's Mill, Bear River, we may assume that the outcrops extending between New Mines and the Quartzite are of strata, which are the extension of the fossiliferous strata between Rice's Mill and Bear River (village) Bridge. I think that I may also assume that Bogart's Quartzite (No. 2), Bear

River, extends eastward to the north of Milner's Mine, and may even be concealed in the obscure interval noticed in the Moose River section. My additional reason for supposing its existence near Milner's is, that the specimen of quartzite containing the singular forms already referred to (Diary Wednesday); as received from Mr. Ditmars, was found there. On comparing the specimen with others from Bogart's quartzite, I find that they are *identical* even in *accidental structure,* such as quartz veins. The position of this quartzite relative to the *Asaphus ditmarsiæ* strata, according to this analogy, will be about a quarter of a mile north, and therefore (geologically) considerably *lower.* Supposing the former to be of Middle Silurian, the latter may be assigned to the Lower Silurian period.

There is considerable variety in the strike and dip of the strata of the area.

The red slates in Deep Brook (Ditmars's) have a strike N. 55 E., S. 55 W., and a vertical dip.

The red and grey slates of Clementsport have a strike N.60 E., S. 60 W., and a dip 43 S.

The strata of the Iron works have a strike N. 55 E., S. 55 W., and a dip S. 51 S., also a strike N. 40 E., S. 40 W., and a dip 40 N. They seem to be folded.

The same below the Bridge of Moose River have a strike N. 45 E., S. 45 W., and a dip 48 S.

The strata in Moose River have a strike N. 60 E., S. 60 W., and a dip 65, S. 30 W.

The strike of the micaceous slates in the vicinity of Diorite (3) is N. 75 E., S. 75 W., dip 74°.

The strata of the outcrop of Purdy's Mountain (diary Friday) have a strike N. 50 E., S. 50 W., and a vertical dip.

The black fossiliferous slates of the outcrop in Bear River, above bridge, have a vertical dip, and also a dip 68, N. 30 W.

The fossiliferous sandstones at Rice's Mill, Bear River, have a strike S. 60 W., N. 60 E., and a vertical dip.

The formation of these crystalline Diorites here, as elsewhere, e. g., and East river, Pictou, and Nictaux, Annapolis, have been the cause of the prevailing metamorphism and disturbance of the

stratified rocks. Two of the Diorites present the same phenomena at their point of contact with the strata, as are found in the localities specified, coalescense as if from contact while the Diorites were in fusion. There is in fact a blending of the crystalline and uncrystalline rocks. To the same cause the peculiar condition (magnetic) of some of the bedded ores is also to be assigned.

Quartzose and Micaceous.—This seems to indicate in a peculiar manner the origin of the strata as well as their relation to the associated rocks. The material has such a granitic character as to impress the conviction that it has been derived from the associated granite. It thus teaches the same lesson as the *condition* of the uncrystalline rocks in contact with granites at Nictaux.—*Vide Paper on Nictaux, Transactions, 1877-8.*

Red and gray argillites of the Moose river section, Bear river and Deep brook, seem to throw light on the geological relations of similar strata at Wolfville and Kentville. Here we have palæontological aid, which was much desiderated, especially at Wolfville (*Paper in Transactions, 1878-9.*)

FAUNA.

Coelenterata.

Corals.

1. *Stenopora.*
2. *Petraia sp ?*

Annuloida.

3. *Crinoidea.*

Annulosa.

4. *Cornulites flexuosus.*
5. *Beyrichia 2 sp.*

Trilobita.

6. *Asaphus ditmarsiæ.*
7. *Dalmanites gilpini.*
8. *Calymene ?*

Mollusca.

Brachiopoda.

9. *Strophomena alternata.*
10. *Athyris sps.*

11. *Spirifera sps.*
    Lamelli branchiata.
12. *Modiolopsis sp ?*
    Gasteropoda.
13. *Pleurotomaria ?*
14. *Maclurea ?*
    Heteropoda.
15. *Bellerophon trilobatus.*
    Pteropoda.
16. *Theca sp.*
17. *Tentaculites sp.*
    Cephalopoda.
18. *Orthoceras ?*
    Incertæ sedes.
19. *Arthrostauros godfreyi.*

Notes on *Fauna.*

2. *Petraia sp?* This coral is small, having a diameter 10 m. m. It seems to be a cast of the top of the calyx. The *septa* are numerous, being distinct around a fourth of the circumference, where the number is twelve, making a total of 48. A *carapace* valve of a *Beyrichia* covers the half of it.

5. *Beyrichia 2 sps.* These are numerous. We have *Carapace* valves of at least four distinct forms, representing, possibly, *two species.* At Nictaux two indistinct valves were found which were supposed to resemble *Beyrichia kloedeni.*

Here they are decidedly different and undetermined.

6. *Asaphus ditmarsiæ.*—This trilobite, which I described and named in the last year's *Transactions,* is one of those giant forms which appear and culminate in the Lower Silurian, and survive to the middle or intermediate Silurian period. Its bedding here is *magnetyte.*

7. *Dalmanites gilpini* is also from the mines, of this I have only a *glabella.* This however is in good preservation. It is broken off at the *occipital* furrow. From this to the front, the length is 19 m. m. This is equal to the width of the *frontal* lobe. The width of the *anterior* lobes is 16 m. m. of the *median* 14 m.

m., of the *posterior* 12 m. m. There is a deep *fossette* on the back part of the frontal lobe, a little above the anterior furrow. It is *papillose* or coarsely granular except in the space between the lateral furrows, there being only two tubercules from the curve of the fossette to the occiput. All the species that have been found in the "Upper Arisaig series" with the exception of *Dalmania logani* occur in B' or Clinton, none of them are papillose. Regarding the species as new, I have named it *Dalmanites gilpini.*

9. *Strophomena alternata* does not occur in our "Upper Arisaig series" but it is of frequent occurrence in the "Wentworth series" of the Cobequid mountains, which I have correlated with the Hudson river or Cincinnati period (Lower Silurian).

10. *Athyris* of several species are found in the forms of casts. This *genus* prevails in the lowest part of the "Upper Arisaig series," being generally associated with corals, which were referred to the genus *Petraia* by Mr. Salter. The *Athyris* then disappears to reappear in great force in the Lower Carboniferous Limestone.

11. *Spirifera* are abundant here as at Nictaux, especially in the Iron mines. It is the prevalence of *Spirifera* that makes me hesitate in placing the *Asaphus strata* lower than the middle Silurian. In the "Upper Arisaig series" Spirifera are most numerous in the Middle Silurian division.

14. *Maclurea, s. p.*—The form which I referred to the genus Maclurea occurs in the specimen of quartzite referred to in my Diary (Tuesday, 15th), associated with the *Cruciform* organism. It is a cast of the top of the shell or *whorl.* The width of the cast is 2.7 x 2 inches, its depth .7 inches.

15. *Bellerophon trilobatus.* Several specimens of this *Heteropod* were found at the mines. It differs from the *Bellerophon trilobatus* of Arisaig in the form of its middle lobe. It is not so rounded, being rather acute, so that it may be regarded as an older variety. *Bellerophon trilobatus* is not found in the Middle Silurian of the "Upper Arisaig series." Its first appearance is in its *crinoid* strata, at the base of C, the Upper Silurian.

16. *Theca, s p.* is very much like *Theca triangularis* of the

Upper Silurian. This is its first occurrence in Nova Scotia, away from Arisaig. It appears to be a *prior* occurrence.

17. *Tentaculites, s. p.*—This is a small *species* like that of B, "Upper Arisaig," Middle Silurian.

19. *Arthrostauros godfreyi.*—This is the *Cruciform organism*, associated with *Maclurea.* Its obvious form is that of a Roman cross, not altogether straight in the body, the lower part of it being bent to the left. It is jointed. The number of joints is eleven. The ninth has two branches or arms of equal length proceeding from it in opposite directions. The right one has a tendency upward, not being altogether at right angles to the straight part of the stem. The joints are compressed bead shaped, and are generally half an inch in diameter. The only form that I have seen figured, which has any thing in common with it, is the *Arthroclema pulchella*, Billings. Of this the joints are differently shaped, and the branches are more numerous. While *Clema* signifying *a twig* is sufficently appropriate as representing the shape of the latter, *Stauros* is more appropriate to the specimen before us.

The *Maclurea and Arthroclema* are Lower Silurian forms in Canada.

Localities.

The localities in the Moose and Bear rivers area, having fossils are: 1st the New Mines. 2nd the Old Mines. 3rd Beaver river above the bridge and at Rice's mill. 4th the continuation of Rice's mill strata, at Moose river. 5th Bear's river midway between the Village bridge and Victoria bridge.

Inferences.

We are thus led to the conclusions—

1. That the *magnetyte* strata of Moose River are not newer than the Middle Silurian Period.

2. That the Quartzites at Bogart's and their eastern extension are of Trenton, if not Calciferous, age.

I have already on lithological considerations, regarded the great quartzites of Gaspereaux River, Kings County, and their associated argillites as possibly of Lower Silurian age.—*Transactions 1878-9.*

Palæontological evidence was in the case of these quartzites and argillites much desiderated. The *Maclurea* and *Arthrostauros* of Moose River may be considered, in a measure, as supplying the *desideratum*.

Certain quartzites and argillites, in Cleveland Mountain, Nictaux, may be included in the same category, as well as other quartzites at Beaver River, *e. g.*, at the joint locality No. 5.

CÆTERA.

I searched for Triassic strata resting on the red and grey strata, as at Wolfville and Kentville, but did not find any. The only formation met with was post-pliocene drift and clays. Red and tough clays were found on the shore and river banks. On the sides of Moose River were observed sections of lofty red banks of drift. In these were abundance of boulders from the North Mountain. Boulders of Basalt and Amygdaloid were found scattered everywhere. Great granite masses were also observed transported from the granite region on the east or south.

Cambrian gneissoid boulders and masses were also found as far north as Clementsport. One mass on the road from Moose River to the Milner Mine, (Diary *Thursday)*, was so large as to seem *in situ*. The original rocks were not found. They may lie concealed on the borders of the granite region, as this was their position at Nictaux.

At Lawrenctown we have observed that the South mountain presents a granite front. Behind this the mountain continues to rise, including the extension of the Nictaux stratified rocks and diorites, wedged between the Lawrencetown and New Albany granite.—(Vide previous paper, Trans. 1877-8.)

Succeeding are the granite heights of Paradise, from which proceeds its river to join the Annapolis river. As Annapolis is approached the South mountain with its granite, and the North mountain with its traps, converge; the valley narrows and the Annapolis river widens into the French and Annapolis Basins. Between these lies Annapolis Royal on a peninsula.

Its Triassic strata, if such there be, lie concealed ; no outcrop appearing all around to give evidence of their existence. The Archean granite and Triassic Traps are only evident. The two

periods, separated by time of duration inconceivable are thus in space, brought into close contiguity.*

From Annapolis the Basin begins to widen, and the mountains to separate. The route is continued along the south side of the Basin over the border skirting the granite rising ground and mountains on the south, which at length abruptly terminate and retreat, to make room for the area of stratified and igneous rocks which has been examined.

Approaching Clementsport, the flat border is widened and becomes on the east side of the port, an area with farms of considerable extent adorned with large and elegant houses.

On the back of this area the ground rises—the soft, red, grey and black slaty strata, as I have observed, being succeeded by the hard strata of the Iron Works. The Episcopal Church is seen crowning the height, while the Rectory is seen peeping out among the beautiful trees on the less elevated ground below.

From the Rectory front through an opening among the acacias, pines and fruit trees, the prospect is beautiful. The port and mouth of Moose River, with its village, wharves and wood crowned heights, is seen extending into the basin, whose wide expanse is bounded on the north by the North Mountain. Over the woody point on the east side of the river mouth Digby town is well seen, and its wonderful mountain gap (Gut) which opens into the Bay of Fundy. The inmates of the Rectory, with the aid of a neat little *Dollond* spy-glass, are able to render the view still more interesting by bringing the distant mountains nearer, by seeing steam boats and ships on their way to and from Annapolis, and by bringing Digby, its churches, residences and inhabitants within sight of the observer.

Going from Clementsport to Bear River the flat and fertile border is still farther traversed.

At Mr. Ray's farm it has its greatest width, his elegant residence seeming at a great distance. The width here is little short of a mile. A great beauty is the abundance of cherry trees with a good crop of cherries. This is the introduction to a celebrated product of this part of Annapolis and Digby Counties.

The story of the early settlement of the district is interesting

A few Refugees—four in number—had all the flat country between Clementsport, as a grant, and part of the hilly region extending to the distance of a mile from the shore. The back hills were afterwards granted to disbanded German soldiers. Hence we have the names Waldec and Hessian Line in the mountains. It appears that a feeling somewhat akin to Jew-Samaritan prevailed between the two classes of settlers.

On the road to Bear river village which turns to the south of the main road, an ascent is made into the mountain. Near the first summit the outcropping rocks diorite, quartzite and slate indicate the origin, age and constitution of this part of the mountain, and its continuation. From this elevation and various parts of the mountain road, (Waldec) which runs on the tract and ridge of the mountains. A panorama to the north, north-east and north-west of Annapolis, the Basin, North mountain, Digby, its gut and neck with St. Mary's bay is truly enchanting. The mountains of course have their vallies, the rocks outcropping in the brooks, in these, account for their existence.

The road on the east side of Bear river, half way between the village and mouth of the river, presents a lovely view. The river somewhat broad winds beautifully on either side, it is mountainous, the heights over the quartzite with its fossiliferous argillite rise abruptly, covered with forest, the long Victoria bridge is seen spanning the river near its mouth, beyond which is a part of Annapolis basin; North mountain closes the view.

Bounding the south side of the district is a long valley, behind which rises parallel after parallel of mountains, which seem to be granitic from the all prevailing spread of granite masses and boulders, without any other rock appearing, or are seen to be granite from the prevalence of solid granite.

At the Bear River end of the great valley, Clements Vale, and the bounding mountain parallel, is situate Bear River village. This village is remarkably beautiful and picturesque. It is set on either side of the beautiful river, among hills of considerable eminence. It belongs to two counties—Annapolis and Digby. It has its wharves, drawbridge and shipyard, and is the seat of considerable trade. A large and beautiful barque, just launched,

lay at one of the wharves alongside of piles of lumber. This was associated with other vessels. In a shipyard above the bridge another barque was on the stocks. This shipyard is a place of Geological interest. The ship stands on one of the outcrops of fosiliferous rocks already referred to. Its numerous churches and elegant houses are worthy of notice. A great charm is the prevalence of ancient and noble oaks, and great, beautiful and productive cherry orchards. The last was an important element in the pleasure of our visit. It was cherry time—there was bustle in cherry picking for export, and local enjoyment. The following Sunday was "Cherry Sunday." Visitors from distant towns and villages were expected to aid the robins, who were remarkably numerous and busy in enjoying and disposing of the cherries. Bear River is evidently a paradise for robin.

Art. II.—Geological Waifs from the Magdalen Islands.—By Rev. D. Honeyman, D. C. L.

These islands are situate in the Gulf of St. Lawrence, between long. 61° 23′ and long. 62°, and lat. 47° 13′ and lat. 47° 52′.

They have a trend N. 45 E., S. 45 W, corresponding with that of Nova Scotia and Cape Breton.

Amherst islands, Grindstone island, Entry island and Allright island, the south-west islands of the group, are all peculiarly elevated according to the Admiralty charts.

In Logan's Geological Map of Canada the formation of the island is indicated as Lower Carboniferous.

My attention has been specially directed to the geology of the Magdalen islands, by specimens brought from time to time to the Provincial Museum.

1.—I received, three or four years ago, two pretty large specimens of Manganese ore, Pyrolusite, from Mr. William Johnstone, of Halifax. These are identical in character with our specimens from the Lower Carboniferous Limestone of Hants, N. S., Teny Cape, N. S., and North River, Colchester, &c. From these I was led to infer the existence of Lower Carboniferous Limestones in the Magdalen islands, having Manganese.

2.—Specimens of Gypsum were subsequently received from Mr. John Boak, of Halifax. These are of character and quality identical with the Nova Scotia Lower Carboniferous Gypsums.

3.—Lately other specimens were received from Mr. John Tucker, of San Francisco. There are, first, a specimen of coarse agate, with cavities containing quartz crystals. Second, three beautiful jasper specimens, blood red, green and yellow.

These are all from Grindstone island; and are evidently trap minerals.

From these observations we are led to infer that the Magdalen islands are of some geological importance, and its minerals of possible economic value.

Their geology appears to indicate the existence of an enormous submerged area of Carboniferous strata lying between Gaspe, Canada, and Port au Port, of Newfoundland, extending to Cape Breton, Nova Scotia and New Brunswick.

On a part of this Prince Edward Island's Triassic Sandstones seem to rest.

Mr. Fox, the collector of customs, who has been a resident of the island for twenty years, informs us that the elevation of Amherst island, Grindstone island and Entry island is from five hundred to six hundred feet; that trap is prevalent, on these islands, that one of the specimens is undoubtedly derived from this.

The first looks like a specimen found in situ; the others may be transported boulders.

The Jasper pebbles are identical with some that I received about six years ago, with beautiful agate pebbles, from Gaspe bay, which lies to the N. E. of Grindstone island.

The Gaspe pebbles are thus referred to in Logan's Geology of Canada, 1863, page 404.

"Associated with these are others (pebbles) of agate and of red, yellow and green Jaspers, often brilliant in colour, which have probably been derived from the Conglomerates of the Gaspe Sandstones. These Jaspers and agates are known among collectors as 'Gaspe pebbles.'" Of course the conglomerates in this case can only be regarded as the secondary source of the 'Gaspe

pebbles,' just as the Carboniferous Conglomerates of the Cobequid mountains in Nova Scotia are the obvious secondary source of many of the rounded boulders and pebbles of Syenite, Diorite and Porphyries which are found in our post pliocene drift.

The Jasper pebbles are supposed to come from the post-pliocene, so that they may have come from Gaspe.

Gypsum was once an article of export to Canada. It is not now exported; Nova Scotian Gypsum is preferred.

Art. III.—On the Semi-Annual Migration of Sea Fowl in Nova Scotia.—By J. Bernard Gilpin, A. B., M. D., M. R. C. S.

(Read March 15, 1880.)

In this paper I wish to call the attention of the Institute to that part of the great semi-annual migration of sea fowl which passes the whole eastern coast of North America, belonging to the coasts of Nova Scotia; of the separate genera and species of which it is composed; of the monthly periods of their passing; and of the modifications both in time, in frequency and in species, which advancing civilization has produced. From the earliest writers and voyagers, not only along the New England coasts, but also of our own Province, we notice mention of these migrations, and are amazed by their numbers, darkening the air and blackening the shores along which they passed. With no enemy save those natural ones, which the economy of nature always provides, they passed north and south without fear or molestation. For the last three hundred years, an advancing population at almost every point on their passage, from Labrador to Florida, has thinned their numbers, altered their route, and perhaps, in one or two instances, changed their route entirely, or destroyed a species. The small part which the shores of our Province of Nova Scotia take in these migrations, or indeed the still smaller part that has come beneath my own personal observation, aided by one or two friends, will be the subject of this paper.

List of water fowl and sea fowl personally noticed in Nova

Scotia. Nomenclature of Dr. Coues, *Key*. North American Birds:—

Branta	luecopsis,	Barnacle goose.
Branta	bernicla,	Brant.
Branta	canadensis,	Wild goose.
Anas	boschas,	Mallard.
Anas	obscura,	Black duck.
Dafila	acuta,	Pin tail.
Mareca	americana,	Widgeon.
Querquedula	netion,	English teal.
Querquedula	carolinensis,	Green-winged teal.
Querquedula	discors,	Blue-winged teal.
Spatula	clypeata,	Shoveller.
Aix	sponsa,	Wood duck.
Fuligula	marila,	Scaup.
Fuligula	affinis,	Little Scaup.
Fuligula	collaris,	Ring-neck duck.
Fuligula	valisneria,	Canvas back.
Buchephala	clangula,	Golden-eye.
Buchephala	islandica,	Barrow's Golden-eye.
Buchephala	albeola,	Buffle-head.
Harelda	glacialis,	Old wife.
Camtolæmus	labradoreus,	Pied duck.
Histrionicus	torquatus,	Harliquin.
Somateria	mollissima,	Eider.
Somateria	spectabilis,	King Eider.
Oedemia	americana,	Scoter.
Oedemia	fusca,	White-wing.
Oedemia	perspiliata,	Surf duck.

Of this list of fourteen genera and twenty-seven species we find that nine genera, with the exception of the genus Aix, and one species obscura of the genus Anas, are more or less rare. Appearing in some years tolerably numerous and then for years not seen. I have never seen myself or heard from others of any Swans being seen in our Province. Of Geese, I had sent me from Sable Island, in the year 1870, an immature specimen which I put down to Leucopsis, especially from the dark line

running through the eyes and on the nape of the neck, the dark wing coverts, and black bill and feet. In 1874, I saw two specimens of the same shot on Halifax common, and in the collection of my friend, Mr. Downs, who considered them the young of the snow goose. With every respect for one who may be called the best field naturalist in the Dominion, I cannot reconcile the black bill and legs with Wilson's description of the pale lake or reddish purple of the bills and feet of the young snow geese shot on the Delaware river, and must maintain my opinion. These are the only specimens I have seen.

Of the Canada goose, his migrations may be said to be regular in the Spring. From after the middle of March to about the middle of April, numerous flocks pass over the land, going north-eastwards, and scattered parties, of half a dozen or more, are found feeding along the shores of the tide ponds and salt estuaries of the Bay of Fundy, the Atlantic coasts, and especially the shores of Cape Breton. Should heavy north-easters prevail these flights are driven down in numbers to the land, and thus every few years wild geese are plentiful in Halifax market during April. I have noted 10th April, 1879, one being shot at Digby, near the Bay of Fundy. The Brants also pass about the same time of Spring, but are less noticed, except during a long period of foggy weather, when they seem bewildered, and cover the flats in hundreds, and are easily shot. The autumn migration of the geese and brants is less noticed. I have no notes of their alighting, but several of the peculiar note of the wild goose heard in October, November, and indeed midwinter. During one Spring, about 1870, the brants remained about Digby, N. S., till the middle of May, becoming very fat though arriving very lean. That these geese, as well as the snow goose, once bred in numbers on the salt marshes of Annapolis County, and that their habits have been altered by advancing population, is well proved by old writers. The early French writers notice the abundance of "outards," both white and grey, that bred on the Port Royal marshes, the white being no doubt the snow goose; and those bred from wild eggs, and carried to France as a royal present, still existed in their descendants, which thronged by hundreds,

in Buffon's time, the royal waters of Versailles, as the "A Canadensis." There are people still alive who recollect that the Brants bred in abundance in St. Mary's Bay when they were children. I scarcely need say that none are found breeding there now, or scarcely alighting, except in some years. This power in the individual bird of prolonging its existence by altering its breeding grounds must perpetuate its race, whilst other races having attachments stronger to one place have died out, and are still, during our own time, diminishing.

Of the next family of true duck or fresh water fowl, with the exception of the black or blue wing duck, and wood duck, which, curiously enough, are resident, consisting of the mallard, pintail, widgeon, the teals and shovellers, they may be said to be rare; never to abound in market, to appear during fall and winter, and chiefly to be found in private collections or in note books of naturalists. Thus I note, "Mallard, young male, no white collar, shot Sept., 1875, Cole Harbor, near Halifax—J. M. Jones." Pintails rather more numerous. Halifax Museum, Young collections,—Mr. Downs and Mr. Egan, males full plumage. Of the teals, blue winged, male full plumage, shot Jan'y, 1880, Halifax; green winged teal, Halifax market, 12 Dec., 1871; male, full plumage, myself; English teal (Q. netion), very rare, mounted by Mr. Downs, with American, to show the difference of species; widgeon, female, full plumage, Jan., 1880, Halifax, Mr. Egan; and a shoveller, exceedingly rare, shot at Digby by my son; and, shot April, 1879, Halifax, male in full plumage. Mr. Egan. From these extracts we find this family rare in individuals, and occurring during winter sometimes, and then in full plumage. Whilst those birds thus make our Province a casual visiting place, it is singular that the blue-winged duck, a true type of the fresh water duck, with its long and low bill, slender neck, legs brought forward, a poor diver but good walker, so closely allied to these genera in all these respects, should be a resident, in company with the wood duck, nearly as closely allied also, yet it is so. Down in the salt marshes bordering the river mouths, just above tide way, we find him nesting in May. In August, the mower with his scythe cuts the young brood scarce-

ly able to fly. At the same time others are nesting along the rush fringed sides of our inland lakes, and the young are protected by their mother seeking their food in the shallow rapids. In 1854, I found them nesting on the low banks of the salt lake or lagoon which makes the centre of Sable Island, some eighty miles seaward from the Province. The nests were very inartificial, more like the circular folding or twisting of the long grass by the duck's body and legs with a few scattered feathers. The eggs were a light bluish green and about ten in number. Whilst in June I saw the mother duck leading her young flock on the lake, I have seen others sitting patiently during the last of July on, perhaps, a second or third robbed nest. If undisturbed they would doubtless remain on these salt marshes till the ice drove them out. Disturbed by sportsmen, they seek the lakes. In September they are found feeding upon the blueberries covering our barrens, and as winter advances, and the frost drives them, they return to the salt marshes, and at last, in deep winter, to the bays of the ocean; thus returning to marine molluscs that furnished their first food. In deep winter he is found nestling beneath the snow, waiting for the ebb tide to bare the rocks from which, being no diver, he collects his scanty supplies of frozen molluscs. On Sable Island he remains as long as the salt lake keeps open from the ice, but returns in the early Spring. This duck may be called both resident and abundant in the Province. Although often and long ago described, yet I cannot forbear describing again a male in full plumage shot at Digby, N. S., 9th February, 1880:—

"In colour, top of head obscure line running down back of neck; shoulders, upper back axillaries and wing coverts blackish, but as almost every feather had its edges brown, the general appearance was brownish. On the top of the head the brown appears in lines, on shoulders and other parts as scales, the lower back and rump black, the tail sooty black, but each feather emanginated. The primaries sooty black, the secondaries having a speculum of blue with purple reflections, bordered above with velvet black and edged with greyish white: the tertiaries having the outside edges velvet black. Beneath the colour and shading of feathers like the upper parts, but lighter. Edge of shoulder spotted black and brown. The upper part of inside wing pure white, but shading off to bluish ash, darker towards the extremities; beneath tail, dark ash. Returning to the head, there is an obscure line passing from behind eye

to back of head. All below the eye, the cheeks, the chin, throat and sides of neck, for about four inches, may be called very pale fawn, as a back ground to numerous dark pencilled dots or lines. In the full nuptial plumage of the male, the border between this lighter neck and the deep brown of the breast becomes very distinct, indeed, with his pouting cheeks, swelling neck and tumid feathers, he looks as if he had an ashey white neck and head. The female and young are less distinctly marked. The bill is long and low, the frontal feathers coming down in a peak, the side feathers in a semi-circle. The colour of the bill is greenish horn with the tips black and a subcircular nail on each tip. The lammella very fine in both mandibles; the nostrils high up. A line runs along the upper mandible from rictus to tip, and a second line above this, from the tip, passes it. The legs are a dusky orange, with a red wash; the webs scarcely black; the soles dusky. The tarsi and toes are uninterruptedly scutellated on their front; on other parts, obscurely reticulated.

Total length, 2 feet.
Length of spread wings, 3 feet 3-10 inch.
" of upper mandible, $2\frac{1}{2}$ inch.
" of tarsus, 2 inch.
" of longest toe, $2\frac{1}{2}$ inch.
Irides, dark brown.
Tail feathers, 16 —

In some young birds shot 1st August, 1880, and still in fine feather, the plumage was much darker than adult, and less diversified by fawn or brownish edges to the feather. The other resident duck we have cannot be called abundant. Unlike the last sombre colored but still very beautiful bird, he is adorned by the most beautiful metalic tints of the tropics, and seems an alien upon our frozen streams. Of the wood ducks breeding here, I have had several specimens of the young, shot August 17th, 1877, near Annapolis Royal, in their first plumage, and not having the white forked collar of the adult. The Indians all maintain he is found mid-winter about the rapids and low falls between our inland lakes, which never freeze. This has been confirmed by sportsmen, and also lumberers, who camp all winter beside these streams, yet he seems out of place, and I fancy not abundant or long to remain. I have never seen him in winter myself. Our next group of ducks, consisting of the Scaups. the Ringnecks, Canvasbacks, the Goldeneyes and Buffleheads, stand immediate between the freshwater and the sea ducks. They are at home equally in lake and ocean. They are expert divers but bad walkers, having the leg thrown far back. Their

bills have become short and high, their forms more robust, necks shorter, and bodies losing the long oval form of the typical black duck, and becoming round and humped, and the hind toe lobulated. With the exception of the Canvasback, of which I have noted two specimens, and the Ringneck, (F. collaris), the only specimens of which I have noted were kept alive by Mr. Downs, and I think were originally young taken in the eastern part of the Province, the other members of this group may be called common. The scaups, bluebills or blackheads, as they are variously called, come into the Bay of Fundy about the last of October and leave us in April. The specimens noted by me were all marilla, but a mounted specimen in Halifax Museum of affinis shows both forms to be present with us. The next group, which Dr. Baird has justly united in his new genus, Bucephala, the goldeneye and buffleheads, are common, coming to the Bay of Fundy in October and leaving us in April. Though not so numerous as the common goldeneye, yet in some seasons the Iceland species may be said to be plenty, in others rare. After a careful study of many specimens of each, both males and females and immature birds, I have been enabled to generalise that both males have the violet wash in the green of the head, though Richardson makes it typical in the Iceland species; that both females have the snuff yellow wash upon their heads, which my friend Mr. Boardman makes typical in the female Iceland; that there is a tendency in both females for the brown to run to dingy duck green on their heads, and that the party coloured bills in both females are very few in comparison with leaden coloured ones; that it appears in some young males, and their fewness can only be accounted for by considering them transient and becoming effaced by adult age. The anatomical difference in the trachea of the males, (paper read March 12, 1878,) must prove them distinct species. Before we notice the next group of purely pelagic duck, which never seek fresh water, are still shorter and rounder in figure, legs further behind, much better divers, but scarcely walkers at all, we may note that both these groups of pure freshwater fowl, and the intermediate one of partly fresh and sea fowl, although they do no doubt perform the semi-an-

nual migration along our coasts, yet are never seen performing it, or are a scene in the landscape. We find them feeding in our inland lakes or dallying about our salt-tide marshes, and we scarcely know if they are successive flights or the same flocks. We have only what may be called stragglers from the eastern wing of the great migration, which doubtless makes the great freshwater streams and lakes their turnpikes further inland, and our rarer species must be the involuntary stragglers that are pressed towards the sea coast by westerly gales. The third group of migratory sea fowl are purely pelagic and procure their living by diving. They never affect the freshwaters or are seen inland. They include the heralds, the scoters, the eiders, the rather scarce harlequin, and the almost extinct Labrador pied duck. Of this last species Mr. Downs secured about thirty years ago the three or four last specimens known in the Province. One of them is in the collection of Col. Drummond in Scotland; Mr. Boardman has one, and the third must be the specimen obtained by Mr. Brewster, of Cambridge, Mass., lately, and marked from Nova Scotia. Wilson, in 1818, speaks of examining many specimens in the market of Philadelphia, and in 1830 it was well known by the gunners of Newport, R. I., who called it the skunk duck, from its black and white colors. It is probable this species is becoming extinct, as the causes of its scarcity appear now permanent. Of the king duck, (S. spectabilis), I have only noted three specimens, in market, Halifax, Dec. 11, 1871, one of which is now in the collection of Mr. Boardman, St. Stephen's, and though a male in full nuptial plumage, has the peculiarity of having no frontal plates to the bill. This species is so eminently pelagic in our latitudes as never to seek our shores unless driven in by gales of wind. The common eider or sea duck, as it is here called, is plenty, especially in the form of the female and immature birds. I note that Mr. Egan informed me he once watched a pair nesting near Halifax, N. S., but this is the only instance that has come beneath my notice. With the exception of the harlequin, which are rare, the old wives, the three species of scoters, and the common eider ducks, make up our true migratory sea fowl.

I note a surf scoter (O perspitiata), a young male, as early as August 8, 1879, shot at Digby, evidently a young bird of the year's; a very early date. From this date to November, the surf scoter, the velvet scoter (O fusca) and yellow-billed or bottle-nosed scoter (O americana) come flying in the Bay of Fundy in small flocks, and remain all winter. I have never noticed the black scoter (O nigra), though given in Wilson, Nuttall and Baird. The American student must feel obliged to Dr. Coues for returning these species to one genus, and in studying their common habits, forms, and especially common colour, and protuberance at base of bills, wonder how any naturalist, either cabinet or field, could ever have divided them into two or three genera. The old wife, or old squaw, comes to us about the same dates with these, and is often seen in company, either flying or pressed to a lee shore by heavy weather, sitting upon the waters. The eiders come in rather later, but are sometimes numerous in Spring. Whilst the semi-annual Fall migration of these sea duck are scarcely noticed, except by naturalists and gunners, whilst in the pursuit of food or warmer seas, they seem leisurely to fill our shores and pass our rocky promontries, whilst some remain all winter, seemingly, as we are unable to say they may not be successive flocks in passing, the returning Spring seems to awake new thoughts and new feelings in all these migratory fowl. Sometimes in February, oftener during March, the garrots cease their perpetual diving; the males, with tumid heads and throats, and more brilliant and purple green reflections, swim in restless circles around the sombre female which, half buried in water, with extended neck and flattened body, evade his approach. The glass-like water is thrown into mimic surf by their play. Or the male throws his purple head far backward till it rests upon his back, and a short shrill cry comes across the water from his upturned bill. The old wives, a little seaward, are playing the same antics, and a prolonged note, much like a distant bell-buoy, directs you to the male, with creamy and pouty head, long snowy axillaries falling athwart a velvet black back, and long tail carried straight and high, is circling around his greyish mates. The coloured gentry in these magic reels, the scoters,

with lake or orange bill, and scarlet leg gleaming from the velvet darkness of their suits, play this game so stoutly that among the hardy fishermen they have gained the name of courting coots. Thus it appears that pairing takes place long before the instinct of migration moves the whole mass northwards. This migration is strongest during April, and lasts into the middle of May. Beginning far away southward and west, Florida perchance, it strikes our westernmost point, Westport, Brier Island, passes along Yarmouth, Shelburne, Lunenburg, strikes Sambro, the western head of Halifax harbour, and pours its tide all along the eastern passages, Canseau, and finally leaves our shores at the north-eastern cape of Cape Breton. For all day long and for many days in fine weather, flock after flock of heralds, scoters, and eider ducks, every few minutes come scattering along, flying low upon the ocean, but rising when passing a rocky point. From many a rocky ledge, or boat anchored to a buoy, comes flash after flash, followed by the roar of a duck gun, and three or four victims falling headlong into the sea. The heralds and eiders seem to perform their flight first, followed by the yellow billed scoters and the velvet ducks, called May whitewing, because they prolonged their migration until May. Thus, as I have said before, these flights are obvious and make a pretty scene in the landscape, whilst the geese, flying high in the air, escape our notice, and the true ducks and their allies disappear as it were unnoticed, but no doubt performing the like migrations on inland routes and fresh water streams. Some fifty years ago, it was my delight as a boy to watch this feathery stream as it flowed by the headlands of Newport, R. I. A respectable and grave set of men called gunners locally, but termed fowlers in law, and having common rights under the "Fowlers and Fishers' Act," pursued this sport with great ardour. They had unwritten but severely respected law, of every boat's exact position on the water, and every man's right of fire on land. They owned a weather stained old grey granite hut called the fish house, with its boats chained all round it, and further away towards the sea, a stone duck fort, a circular wall of dry stone, titanic, and looking so like what I have in after years seen the

Micmacs dwelling in, on the rough shore of the Bay of Fundy. They shot from long ducking guns, with buccaneer stocks, (the front of stock very convex,) flint locks, and every man measuring his charge in his palm, from a long curved powder horn; and yet they were good shots; and on the evening of a soft April day, the fog clinging around Brenton's reef, it was a pleasant sight to see them slowly following homeward, with their big spaniels and lusty Newfoundlands, two or three horse loads full of game, each horse piled high with a feathery pyramid of black and grey, gleaming with scarlet bits of leg or bill. It was rare then to see four wheeled waggons; a manlier generation used horseback, sometimes the old two wheeled chaise. These men knew the Labrador duck, now nearly extinct, and taught me to identify the Huron scoter, for which I vainly sought in Buonaparte's catalogue, N. Y. Lyceum, and which in after years was first scientifically described by Herbert in American wild sports, allowed by Baird, but denied by Coues. Whether this sport is still carried on, by breech-loaders and patent shell, I know not, but must return to our own part of the stream, and the modification time and civilization has wrought in it, not referring again to the ancient voyagers. The opinion of those most interested in it steadily maintain its rapid decrease, or at all events its alteration of route. Wilson speaks of birds now almost extinct as found in the markets. M. Audubon, speaking of the sea ducks in the Bay of Fundy, says "that by the 10th August they (eiders and scoters) are so naked of feathers and destitute of quills as to be unable to fly, and are clubbed by the Indians, sometimes to the number of two hundred and fifty in one foray, being unpaired birds remaining from the previous winter." With a fair knowledge of the southern coasts of the Bay of Fundy, and of the Indians about them, I can say these are the stories of former days, and that no such hunts are made now. Even in Labrador their numbers are declining. In the official reports of the Dominion of Canada for 1878, it is stated that the Mingan Indians, during the summer of that year, were reduced to comparative starvation from the absence of feathered game on the sea coasts. We may take the fate of a kindred species, the great

auk, now universally admitted to be extinct, as a forewarning of the fate of others. If we admit, as indeed every one must, that Joseph Josselyn Gent, when writing of "N. England's varieties," 1672, was describing under the name of wobble, the great auk, then used as food and common in New England in June, "an ill-shaped bird having no long feathers on their pinions, which is the reason they cannot fly, not much unlike the penguin," the complete extinction of this bird shows what the presence of man can do. A bird organized for existence in temperate zones is pushed backwards to arctic lands, and those unable to adapt their organization to its new habitat perish. It is singular that the species now supposed to be becoming extinct, the Labrador pied duck, differs from all its co-genera in having a membranous bill, and is allied (Coues) to a soft-billed species in New Zealand in this respect. May we not look to this feature among the causes of its inability to maintain that position which other species around it seem able to do. There is a growing tendency in the guillimots, the puffins, and razor-bills, to become scarce about the shores of the Province, and they are less easily obtained by collectors than formerly. The family of gulls and terns, with the sheldrakes, both mergansers and goosanders, including the hooded, breed here; all the species of sheldrakes, and many of the gulls, and none of them diminishing. Yet in early autumn the numbers of gulls which arrive show that we owe their presence to migration. I had scarcely noted, Tusket, Bay of Fundy, Sept., 1879, a laughing gull (L. atricilla) for the first time, before a letter reached me from my friend Mr. Boardman, St. Stephen's, saying it appeared on the St. Croix with other southern species about the same time. Of very rare species that have reached us may be mentioned the tropic bird, the frigate pelican and the purple gallinule, from the south, and the pomerine jagger from the north, and all after very heavy storms; the jagger after the one predicted by Saxby, Oct., 1869, and the gallinule Feb., 1870, a few days after the hurricane in which it was supposed the "City of Boston" was lost, and which the transport "Orontes" barely survived.

I have thus in this paper made a study of that portion of

these semi-migrations that touched the shores of Nova Scotia, endeavored to show the different families of sea and fresh water fowl which compose it, their various routes, and the causes that produce this variety. Some passing over the land, aerial, scarcely noticed save by the fowler or naturalist, others taking the inland water courses, and those which visit us being almost involuntary stragglers from this great western flow. Others again making the sea their pathway, and whose numbers make them common in our markets and observed by all. I have only stated what came personally to my notice or from a few friends, thinking that the narrowness of the range might be made up by the more exactness of the matter, and that perhaps others on other parts of the route may, or perhaps are now doing the same, and thus a complete account of the entire migration from personal facts be obtained. Whoever studies it is now aware he is studying a feathery stream that no longer overflows its banks, but is ever growing narrower and narrower, species dropping out, individuals diminishing, its route altering, perhaps lengthening. It is beyond doubt that that amazing feathery stream, that darkened the air, blackened the coasts it alighted upon, that had streamed on for ages, indifferent to the arrows of the thinly scattered red man, made its breeding quarters far to the southward of their present home. It is certain the snow and the Canadian goose once visited Nova Scotia, and the extinct auk spent his June in Connecticut. These, perhaps, are the most arctic species now, and we have a right to infer that the less arctic ones followed their habits. The very presence of man, with his boats and ships, has done much towards this; but the alteration of their food from the ocean, caused also by his presence, his works, his wharves and docks, his pollutions, have driven away their food fish, and made them seek it in northern climes.

By whatever means, however, this feathery stream has been diminished, altered or shortened, it leaves us some speculations of the past and for the future. Are those arctic forms now breeding at Hudson's Bay the same as once bred in sunny Connecticut; have they changed in three hundred years, or are we

wrong in asserting that an especial form is necessary for every zone, and that one form would not be sufficient for both places; or may it not have been that the great auk, with a form according to every naturalist of the purest arctic, flourished better in these warm seas, with this form, and owes his extinction to being pushed to where it was not adapted for existence.

On a Cub Found in a Bear's Den, Jan. 12, 1880.—By Dr. J. Bernard Gilpin.

On the 12th January, 1880, Stephen Bradford, an Indian, hunting moose in the County of Digby, Nova Scotia, discovered a bear's den,—seeing the dark skin of the bear beneath the roots of an overturned tree, covered by its mantle of snow. His gun being foul, he exploded many caps, and succeeded in arousing the bear from her hibernation. Before he could discharge the gun, she left her den, and he then tracked her through the forest in the snow for a mile and a half, when she denned again. He returned to camp, cleaned his gun, and returning shot her, for she proved a she bear, in her temporary den. Missing his coat, he returned to the first den, where he recollected throwing it off, and there found a cub dead and frozen. This cub he took to my son, who was in camp at the time, and who sent it to me. Its weight was eleven ounces. It measured, when stretched out, from tip of nose to end of hind toe, between ten and eleven inches. It was covered by very fine close hair, black upon the back and head but bluish slate towards the belly and inside of limbs. The ears were naked; the eyes closed; the tongue exposed, and the jaws slightly open. There were no teeth, but the claws were much developed, and the tail long. From the umbilicus being entirely healed, and no cicatrix upon it, I judged it to be about ten days old. After a careful and measured life-size sketch, it was placed in alcohol. Though we gain nothing new by the possession of this most rare specimen, yet we verify personal observation, and by date, statements which have come down to us since the days of Pallas, and repeated by Richardson, Godman, and Audubon. Allowing the

cub to have been ten or twelve days old when taken, from reasons I have before stated, it puts its birth about the first of January. Our snows rarely fall to any depth before the middle of November, and our bears usually seek their dens about that period for hibernation. The male bear is easily satisfied; behind the root of an upturned tree, a mass of tangled wood, or a hollow cliff in a rock serves him, and the snows soon cover him in his rugged sleep. Not so the female, if parturient. She selects the most obscure and hidden places, lining them oftentimes with layers of spruce fir branches. It is an unquestioned maxim with Indians, that no one has ever taken a she bear with young. This is both owing to the obscurity of her hiding place, and the asserted fact that if disturbed she will always abort. My son in hunting some years ago, came upon many spruce firs with their lower branches torn off and strewed about the snow. His Indian told him it was the work of a she bear lining her den. Hard by they found a crevice in a ridge of rock, which, after ascertaining it had no occupant, he entered, crawling upon hands and feet, with his Indian holding his leg. The interior was a comfortable apartment in which he could sit upright, floored by spruce boughs, and which no tired hunter would refuse as a resting place. But it is not usual to find so comfortable quarters as these. Richardson quoting from Pennant, and Godwin, both attest to the truth of our Indians' assertions regarding the deep privacy of the female in denning. The former saying, in very severe winters many bears migrate south, but no females found amongst them; and the latter asserting that out of many hundreds of males only two females were found, and those not with young. The hard and early winter had prevented the males from obtaining that condition of fat necessary for hibernation and therefore they became what our Indians call wandering bears, never denning. Instinct compelling the female to do so, as well as her being always in the proper condition, when the male is wasted by the September rut. A party with whom I was hunting in 1841, met and killed one of these wandering bears on the first of March. Our Indians also corroborate the assertions of the older naturalists, that though the bear comes

out of winter quarters very fat, it all wastes in a few days. As to the degree of hibernation attained to, Stephen Bradford's narrative is verified by other Indians, and by observation of tame bears. In captivity, especially if well fed and housed, some never hibernate, but sleep much more during the winter. Others you may force into hibernation by want of food, and confining them in a dark cellar. They have been noticed in coming out of their houses into an atmosphere nearly at zero, to be covered by a thick mist of condensed invisible sweat; this is the vapour hanging over their dens in the forest, and conducting the Indian to them. They are never entirely unconscious, being poked by a stick they will growl but relapse immediately again, and it requires much poking to arouse them, as Stephen Bradford's bad powder and dirty gun did in his narrative. Having thus, as one may say, re-verified by personal observation and modern research, what are the recorded facts of the older naturalists as well as the traditions of our Indians, who have never read a book or heard of a naturalist, we may pass to those considerations which the finding of this most rare specimen has drawn our attention to, as regards its condition both within the womb and its nutrition after birth.

That so highly organized an animal as a bear should be able to retain not only his vitality but his animal heat, and his muscular strength for the space of four months, without any food whatever, is sufficiently wonderful, knowing as we do, that in this time, if there be no supply there is no waste, save perhaps of animal heat. But when we consider the female, we find there is waste and no supply. The material for a second life, and its growth, must be taken from an accumulated fund. Taking the middle of September as the time of conception of the individual before us, and allowing she went into winter quarters about the middle of November, she then carried within her a fœtus of two months old. This fœtus she sustained, and eliminated substance for its growth for six weeks, with no exterior resources, and in a profound torpor. This torpor spreads over all organs of the body, save those of the womb. About the 1st of January, as most certainly is proved by the conditions of

the cub, it must have been born. An atmosphere, saved only by the animal heat of the mother from that without the den, often approaching zero, and a torpid mother, awaits this blind born, feeble offspring. As no personal observation can ever assist us, we may only conjecture that some instinct leads it to the mamma where, like certain marsupials, it retains a firm hold upon the nipple ; and now a change comes over the still torpid parent,—the blood that thus far carried nutrition to the fœtus must, as it were, change its base,—the circulation of the uterus shrinks and becomes obliterated, whilst that of the mamma must correspondently increase and allow the lacteal glands to secrete milk. And all this performed with no assistance without, but from sources accumulated nearly two months ago. To suppose the parent is roused during parturition scarcely accords with the analogy to the facts which we do know, that is, her torpor during lactition. Besides, modern science has caused, by the use of esthetics, the whole phenomena of birth to be performed without the knowledge of the parent; and, moreover, the care during lactition, which we know is performed during torpor, is more wonderful. The most wonderful fact is, that no food is taken by the parent during both operations. Dating the birth at the first of January, three and a half long dark months must this torpid mother secrete milk before she emerge into light or procure food for herself. The appearance of the cub at ten days old, its leanness, its weight (eleven ounces), the parent sometimes weighing five hundred pounds, attests that the amount of uterine nourishment it had then received was of the smallest quantity. It was scarcely the size of a pup, one say of six or seven the litter of a bitch weighing thirty or forty pounds. That after birth it receives but little food, and passes the most of its life in semi-torpor, and scarcely grows until the parent emerges, we can only prove by their extreme smallness when found in early Spring. Unfortunately I have no dates to those I have seen at that age, or to a pair of young Polar bears I once saw, in whose instance the retreat must have been doubled in length and severity by the Arctic latitude and ice formed den. We may here remark, that in our bear hibernation destroyed all maternal instinct;

she fled from her cub; it seems probable no maternal duties had bound it to her. Had Stephen Bradford, with his dirty gun, met her in May, he would have been only too happy to have escaped with his life instead of going to camp with her skin.

In its production of young so comparatively small, and in its privacy during parturition, our bear has an affinity to the opossum, our sole North American marsupial, but without the pouch; and from these facts, as well as its hibernation, and its capacity of sustaining life either as a vegetarian or a carnivora, may justly be considered in its Polar or fishing variety one of the first mammals that occupied this continent on rising from its glacial submergence. The Polar variety, but few shades above the walrus, might easily have sustained life for the few short summer months on fish and seals, ere yet the emergence of rock peaks, or swampy terraces; and when a tardy vegetation was clothing these plateaux, and before the herbiferous races appeared, his descendants straying landward thrived upon this vegetable diet, till these races appearing after their natural food had grown for them, allowed him again to become a carnivora. In this struggle of fish, vegetable and flesh life, his prolonged torpidity, perhaps at first much more prolonged in arctic regions, and destined as he advanced to warmer climates to cease, must have been of wonderful use in his struggle for existence.—*Communicated by the Author, Jan. 26, 1880.*

ART. V.—NOTES ON THE ANATOMY OF A SEAL FROM MAGDALEN ISLANDS.—BY J. SOMMERS, M. D.

(Read Feb. 9, 1880.)

IN bringing to your notice the following points on the anatomy of a seal, I take occasion to express my sincere thanks to the gentleman through whose kindness I have become indebted for the opportunity to conduct an interesting investigation.

The Seal was sent from Magdalen Islands by J. B. F. Painchaud, Esq., to Robt. Morrow, Esq., who conjointly with myself made the dissection. I wish also in this place, and feel that I carry the members of the Institute with me, to express the feelings of regard that I entertain for the spirit which actuated our

friend Mr. Painchaud, in that he had voluntarily undertaken trouble to aid us in the promotion of the objects for which our Institute has been established. Could we infuse the same spirit into the minds of many friends less remote from us, whose opportunities are probably not less than his, our Transactions would before long, supply to investigators all material knowledge required for acquaintance with the extent of our natural productions.

It is right also that I should make explanation here of what the subjoined notes will render apparent, viz: that our study of the Seal was far less minute and less perfect than it might have been. When it arrived in July, decomposition had set in, the heat of the weather at that time increased the process, which went on with great rapidity, notwithstanding it had been carefully injected by Mr. Skelly, the Janitor of the Medical College, who was careful also to keep it surrounded with disinfectants, yet the changes were not checked to any extent. The above circumstances necessitated a speedy dissection, and although the vessels were well filled with injected matter and under other conditions could have been easily followed out, we were compelled to confine our work to the study of our subject, more from a zoological than from an anatomical stand point.

The following are the notes taken July the 2nd, 1879, and subsequently on days when the dissection was carried on—the subject, a young specimen of Phoca Grœnlandica, supposed age, third or fourth month, length from muzzle to tip of tail three feet, weight eighty pounds, the cuticle having peeled in many places a description of the pelage was not admissable, colour of hair was a dirty yellowish white, the skin viewed as a whole presenting where the cuticle remained, the dark markings or spots commonly observed on seal skins from Newfoundland and Labrador, the anterior and posterior extremities had each five digits, the nails on the anterior fingers were strongly developed, those on the posterior not so large.

The animal had been caught in a net and despatched by a blow on the skull which had fractured the bones, general shape of head broad oval, length from muzzle to occiput, ten inches,

eyes fine dark prominent, with a strong nictitating membrane, which in the dead animal could be made to cover two-thirds of the globe, nostrils closed by valves or folds of mucous membrane, external ear without appendages, the meatus opening by an oval aperture upon the skin of the head in the position usual in mammalia, the meatus was beset with soft bristles, depth of canal of external ear, i. e. from meatus to tympanum one and one half inches, the body on the removal of the integument presented a well nourished appearance, the sternum was prolonged upwards to the top of the larynx by a cartilaginous extension, this measured three and one half inches above the clavicles, and gave origin in its whole length to portions of both pectoral muscles, these muscles arose as in the human subject from the sternum and ribs in front, but the great pectoral was continued downward to the point of the ziphoid cartilage, their insertions the same as in man, viz: to the clavicle humerus and scapula, the positions of other thoracic muscles are so similar to the corresponding parts in human anatomy I deem it to be unnecessary to proceed with their description.

The development of these muscles in the seal corresponds more to the same in birds than in land mammals, the shoulder muscles are also correspondingly developed, the trapezius very thick, deltoid and biceps short, thick, and strongly attached to the bones, these points in the myology of the seal can be seen only on dissection, they are covered by the general integument nearly down to the wrist joint, as however the integument is loose the bones short and articulated at opposing angles, there is much freedom of movement in the anterior limbs.

The modification of the bones at the extremities, furnishes a most striking peculiarity in the anatomy of the seal; in the superior, the scapula is broad, rounded at the edge, bearing some resemblance to the same bone in man, the fossæ for the supra and infra spinati muscles are deep, the under surface of the bones are deeply concave for the lodgement of the large sub-scapulars, the humerus very short and thick, the ulna and radius also short, but the olecranon process of the ulna is much prolonged to afford attachment for the powerful extensors of the arm, the metacarpal

and phalangeal bones are developed out of proportion to the bones of the forearm, taken together they have a much greater length, the flexors and extensors of the wrist, &c., are short and thick, the tendons are long and well developed.

The inferior extremities of the seal are also confined in the general integument, the bones being shortened and otherwise modified as in the anterior extremities, yet every bone is present as in man, the gluteal muscles are short and well developed, but it is evident from dissection that the other muscles of the hind limbs in the seal are not so well developed as the corresponding organs in the anterior members, the articulation of the femoral bones, and the insertion of their muscles are such that the inferior extremities are twisted so that the tibial bones are external to the fibulæ, owing to this the palmar surfaces of the feet become opposed to each other in a position similar to that which can be produced in the hands of man by the partial rotation of the radius upon the ulna.

The phalangeal bones of the feet are longer than those of the forelimb, the claws are not so large, the tegumentary covering broader and looser allowing great freedom of movement in these parts which are readily observed to be specially adapted for progression in the water, while comparatively useless for the same purpose on land. The tibiæ and fibulæ were free.

Opening the thorax, the viscera were examined; larynx and trachea same as in other animals, the rings of the latter being, however, complete; right lung, upper lobe distinct; middle and lower imperfectly divided or marked off from each other; left lung distinctly two-lobed; weight of lungs and heart, $1\frac{1}{2}$ lbs.; heart large, notched at the apex, denoting imperfectly the septum between the ventricles, four-chambered; the foramen ovale open, Eustachian valve not more marked than in the heart of adult human subjects: ductus arteriosus not present. The aorta gave off separate subclavian and carotid arteries for either side. The anatomy of the vascular system in other respects differs not from that of man.

Of the abdominal viscera, the stomach was large, having the bagpipe shape of the organ in carnivora, being also simple; it

measured when distended about 14 inches in length, by about $5\frac{1}{2}$ in width. There is a permanent constriction at the junction of the middle with the pyloric third due to the muscular fibres dividing the organ into two imperfect cavities. The intestines measured in length 42 feet, 3 inches; diameter, about $\frac{3}{4}$ of an inch. Mucous membrane of both stomach and intestines, desquamating, was not examined microscopically. There were no valvulæ in the intestines. The stomach, &c., contained shrimps, partly digested herrings and bones. The liver had so far decomposed, its dissection or examination was rendered impracticable, no gall bladder was observed, although some attention was given to its discovery. The spleen and pancreas were not noticed; the kidneys were moderate in size; the urinary bladder small, oval shaped; ureters much larger, "thrice," than in man; urethra measured from neck of bladder to tip of penis about thirty inches. The animal was a young male; the generative organs small. The penis was contained in a sheath or pouch of the integument of the abdomen, this sheath extends from the vent upwards towards the umbillicus, enclosing the organ so completely that a superficial glance would lead to the supposition of its being entirely absent. The penis is provided with a long bone, situated or in connection with the corpora cavernosa; the diameter in this young animal being about that of an ordinary lead pencil. The testicles are within the abdominal cavity. The spermatic cords and vessels on either side pass through a very long abdominal canal, with internal and external rings, as in man. They pass up the abdominal wall to join the root of the penis. The testicles contained no spermatozoa. The penis could be made to protrude from its abdominal sheath.

Any remarks which I am inclined to make in reference to the seal will refer only to the organs of progression, and taking the evidence afforded by their anatomical structure, it is easy to draw the following conclusion, viz.: so far as the two pairs are concerned, their uses are entirely different. The shortness and restricted movements of the anterior extremities renders them but of little moment in swimming. The great osseous and mus-

cular development of these organs, along with the strength of the claws, renders them adaptable for climbing. The seal raises its own weight out of the water by means of its fore limbs; it uses them also, when on land, as a means of progression. While moving in the water they are at rest, held tightly against the body, upon the ice or solid surface the palmar surfaces of the anterior flippers are underneath. The tips of the fingers approach from side to side, and the olecrenon processes point outward. The posterior limbs under like conditions are not brought into use, they trail out behind, their edges resting upon the support. They may be said to be practically useless as organs of locomotion on land, but their shape and structure eminently fits them for swimming. They present broad, flattened surfaces to the water, the regular contraction of the extensor muscles of the leg and foot causes the latter to flatten and spread; by contraction and relaxation of the hip and thigh muscles, the thighs are drawn towards the abdomen and then suddenly projected from it; the broad feet striking the water, drives the animal's body forward by a succession of jumps. The seal moving in the water does not swim smoothly like a fish; on the contrary, the propulsion is due to successive arching and straightening movements of the lower portion of the body, resembling very much the movements of a shrimp propelling itself by its tail. We must not forget that the hind limbs of the seal are somewhat in the condition of those of a human being, whose legs being enclosed in a bag, with his feet free, the only movement he could accomplish would be that of leaping, by drawing his thighs towards the abdomen, throwing his body forward from the soles of his feet. The hummocky motion of the seal on land described by many, is due to their being used in such a way as described above; but as the soles of their feet cannot be brought upon the ground or ice, the animal rests upon his knees or heels, and attempts to use them as the moving point. The natural condition of the organ renders them facile in threading water, but makes them awkward and inefficient for like purposes on land or ice.

Of the whole family, the sea lions are the only ones that can

rest with the palmar surfaces of their extremities upon the land, because there is greater freedom of leg and arm than in our seals. They move more freely and with greater rapidity when on land, nevertheless their movements are on the whole very similar to those of our own species.

NOTE—The tentorium cerebellum partly of bone as in cat, falx cerebri at its junction with tentorium also formed of bone.

ART. VI. — TUBES IN THE FEET OF THE MOOSE. — BY R. MORROW.

Read May 10th, 1880.

IN April, 1877, I read to you some "Notes on the Caribou," (see vol. 4, *Transactions N. S. I. N. S.*, page 281, *et seq.*,) in which I drew your attention to the tubes in the feet of the moose. I shot last December an old cow moose, in the hind feet of which the tubes were fully developed, but differed from those in the hind feet of the bull described by me (see page 292, *ibid,*) in being more perfect in shape, closely resembling the tubes in the hind feet of the old doe caribou, that is, being much narrower and more perfectly defined in their mouths, and of nearly equal diameter to their inferior extremities, also being very strongly marked, as in the caribou, by the coarse, bristly tufts of hair which issue from their mouths. The inferior extremities of the tubes are attached, as in the caribou, by strong fascia to the superior surface of the skin of the web, or soles of the feet.

In the fore feet the tubes were nearly obliterated, existing only as a slight depression in the skin, about one inch in length, the tube proper being so reduced as scarcely to be perceptible; this depression, lying between the phalanges, is attached as in the hind feet, by fascia to the sole, but the fascia extends to the middle of the depression, marking what was originally the lower extremity of the tubes, and it is therefore of greater length than that in the hind feet. There were no bristly tufts marking the tubes in the fore feet of this cow moose, as are in the fore feet of the doe caribou.

Art. VII.—Notes on the Bones of Salmo Salar Specimen from Labrador. By R. Morrow.

Read April 19th and May 10th, 1880.

Spinous Rays, &c. Beginning at the junction of the dorsal ridge with the occiput there is a bony process in advance of the first spinous ray; flattened vertically, somewhat broader above, but stouter below, it is attached to the dorsal region by stout fibrous tissue, its ventral extremity at about midway to the 1st spinous ray, and it is the first interspinous bone;* it is entirely different in form, from its representative in the ubiquitous perch, and were it cut out and looked at merely as a fish bone, few would recognize it as an interspinous bone, from the description of such bones as usually given.

2 & 3. The 2nd & 3rd spinous rays have each a short interspinous bone attached to their extremities, overlapping posteriorly.

4. This ray is without the intersp. bone.†

5. The 5th spinous ray has its interspinous bone overlapping in front, and rather longer than those belonging to 2 & 3.

6—15. All these sp. rays have their intersp. bones overlapping anteriorly, but the 15th spinous ray curves posteriorly rather more than Nos. 12, 13 & 14, and at the 15th sp. ray there is an extra interspinous bone $\frac{2}{14}$ (making 2 bones, $\frac{1}{14}\frac{2}{14}$) which does not reach, but its end is opposite the front of the 15th spinous ray, distant about one-quarter of an inch from it; it does not rise so high in the dorsal region as the other interspinous bones, say $\frac{1}{4}$ of an inch less than $\frac{1}{14}$ ($\frac{2}{14}$ lies immediately behind $\frac{1}{14}$, from which it is distant about $\frac{1}{8}$ an inch); $\frac{1}{14}$ and the preceding intersp. bones are nearly equidistant from each other; $\frac{2}{14}$ is very nearly a straight bone, tapering slightly from its dorsal to its ventral extremity. The dorsal ends of the 14 interspinous bones have somewhat broad heads‡ for the attachment of the muscular tissue, and all are curved anteriorly.

16. This spinous ray is without an intersp. bone, but the 4th intersp. fin bone of the dorsal is slightly in front of it.

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*In younger specimens this 1st intersp. bone has almost always its ventral extremity lying between the superior extremities of the 1st spinous ray; as this ray becomes more solid, the intersp. bone seems to be pushed out.

†In a fish from Cape Breton the 4th has an interspinous bone, but the 5th is without.

‡More perceptible in smaller specimens.

16 & 17. Between the points of these spinous rays* is the 5th intersp. fin bone, and at the 17th begins the shortening or hollow in the sp. rays for the insertion of the dorsal fin.

17 & 18. Between 17 and 18 is the 6th intersp. fin bone.

19. Opposite the point of 19, perhaps slightly in front, is the 7th intersp. fin bone.

19 & 20. Between 19 and 20 is the 8th intersp. fin bone..

21. Nearly opposite the point of 21, slightly in advance of it, is the 9th intersp. fin bone.

22. Nearly opposite the point of 22, perhaps a little anterior, is the 10th intersp. fin bone.

22 & 23. Between these, slightly in front of 23, is the 11th.

23 & 24. Between these, slightly in front of 24, is the 12th.

24. Opposite 24 is the 13th intersp. fin bone.

24 & 25. Between these, slightly in front of 25, is the 14th.

26.† Slightly in front of 26 is the 15th intersp. fin bone; at the posterior junction of these intersp. fin bones with the fin rays, and attached to the prolongation of the 15th intersp. fin bone from its lower extremity, the fibrous tissue descending and attached to *26, 27, 28, 29, 30*—the 26th, 27th, 28, 29th and 30th spinous rays is rather stronger than that which is attached to the other sp. rays. The height of the intersp. column from the centre of the vertebræ; at right angles to the junction of the fin rays, is at the anterior face of the dorsal fin 3½ inches; at the posterior face, 3¼ inches; length of dorsal from anterior to posterior edge is 3¾ inches, and, including the prolongation of the 15th intersp. fin bone, 4¼ inches.

29-42. From, and including 29 to 42, the superior caudal spinous rays are wider at their dorsal ends than are the other dorsal sp. rays; from 26 to 42, the height of the dorsal sp. rays is nearly *42–53.* equal, and from 42 to 53 they rapidly decrease in length, and their dorsal ends are comparatively narrow.

54–55. At the point of this sp. ray begins the upper or dorsal portion of the caudal fin (the ventral portion begins also at the 54th). The 54th and 55th sp. rays are anchylosed at their

*The shortening of the spinous rays for the insertion of the dorsal I do not find in some specimens of the Cape Breton Salmon.

†The hollow for the dorsal is here completed and the spinous rays begin to rise.

bases, and towards the anterior dorsal edge of 55 the bony plate nearly touches 54.

55, 56, 57. Are anchylosed, and on 57 is the last dorsal spinous ray proper; but in addition, and anchylosed with the three spinous rays above named, are two or three other rays, which may be termed representative. I cannot decide their number they are so confused. These three rays unite with a short bone, which is attached to the 57th sp. ray, and lies nearly parallel with the 57th and 58th spinous centra. The 57th spinous centrum begins to rise, that is, to curve upwards towards the dorsal edge of the caudal fin, and with the 58th and 59th centra and the lower Y shaped bone between the forks of which the notochord passes, forms an angle with the anterior part of the spinal column of about 35 degrees.

Saddle bones. Beginning at the posterior edge of the 56th centrum are a pair of bones of irregular and peculiar shape, one on each side of the spine. They are attached to the dorsal edge of the spine, and are joined by strong cartilage in this specimen, by their ventral anterior edges to the posterior edge of the 56th centrum, covering the ventral end of the 57th sp. ray, anteriorly about $\frac{1}{8}$ of an inch, nearly at the middle of its height; their dorsal edges pass over the 57th sp. ray, posteriorly they cover and attach the three rays which do not reach the spinous centra, 58 and 59. These bones, which, for lack of a better name, I will call *saddle* bones, attach the three rays which I have already spoken of as representative rays, by cartilaginous union to the spinal column. When these bones are in their proper position the spinous rays appear to be all perfect; but the 58th and 59th centra have no dorsal spinous rays. Close to the posterior end of these saddle bones, protecting the notochord, and lying under the anterior edge of the short caudal fin ray, No. 10, reaching nearly to the dorsal edge of the spinous centra, is on each side a short irregularly shaped bone, about $\frac{3}{8}$ of an inch in length, somewhat pointed at either end. On the outer sides of the posterior extremities of these two short bones, the points of the short caudal rays next to the first perfect dorsal caudal fin-rays, right and left side, have a slight attachment.

The next bone we meet has its anterior edge divided, that is, it is Y shaped, so as to admit between its points the passage of the notochord, together with its protecting tissues, and the posterior edges of the saddle bones nearly touch the points of this bone. Its posterior or outer edge is united, but in a younger specimen would probably be found as two separate bones. This bone is of the same shape, but about half the size of the Y shaped bone to be noticed in the ventral aspect of the spinal column.

I have thus reached the dorsal extremity of the spinal column, not including the spongy centrum to which the fourth or upper hypural bone is attached, and which makes, if included, 60 vertebræ.

Spinal Column, Ventral aspect—Ribs.

C 1 & 2. There are no ribs on the 1st and 2nd centra, these being so situate as not to require them, but there are their representatives in the shape of processes.

1st pair on 3rd. From the 3rd centrum, at its lower edge spring the first pair of ribs, which are somewhat crooked in shape, and naturally shorter than the others. They are comparatively round bones, and in length from articulation to point 2 inches.

C. 4. The second pair of ribs, measured in a direct line, that is, not following their curve, are $2\frac{3}{4}$ inches in length and slightly deeper measured transversely than they are laterally, and taper to a point.

C. 5. The third pair are $3\frac{1}{4}$ inches long.

C. 6. The fourth pair are $3\frac{3}{4}$ inches long.

It is not necessary to give the lengths of the remainder of the ribs, but it may be remarked that I find in the salmon, that the first two pair of ribs may be termed short, and that from and including the 3rd pair, to and including the 13th pair, they are of much greater transverse than longitudinal diameter, decreasing in the length of the transverse breadth as they succeed each other posteriorly—7 to 12 are the longest and broadest ribs. The remaining ribs are widest at their attachment and gradually decrease in size towards their points.

C. 27. At the 25th pair of ribs on the 27th centrum are a pair of

very short spinous processes lying in front of their articulation with their centrum.

C. 28. The 26th pair of ribs have spinous processes about $\frac{1}{8}$ of an inch in length, to which they are attached and pass posteriorly to their articulation.

C. 29. The 27th pair are united by cartilage to the end of, and behind spinous processes $\frac{1}{2}$ an inch in length on the 29th centrum, their ends do not reach the centrum but are attached posteriorly to the sp. processes. This pair are not so flat as their preceding ribs.

C. 30. The 28th pair. The spinous processes to which this pair are attached are $\frac{5}{8}$ of an inch in length, and their attachment rather more than a quater of an inch.

C. 31. The 29th pair are attached posteriorly to strong sp. processes $\frac{5}{8}$ of an inch in length, which are united transversely forming the first hæmal arch.

C. 32. The 30th pair. Their spinous processes are also about $\frac{5}{8}$ of an inch in length to which the attachment of the ribs is about $\frac{3}{16}$ of an inch.

C. 33. 31st pair of ribs } have sp. processes $\frac{3}{4}$ and $\frac{15}{16}$ of an inch
C. 34. 32nd do. } in length, and have short attachments to their processes.

C. 35. On this centrum, (the last of the abdominal centra), attached to spinous processes, which are united at their ventral ends, are the 33rd and last pair of ribs. A hasty examination of this specimen might lead one to say that it has only 32 pairs of ribs; but the dorsal ends of the 33rd pair are attached closely together and to the narrow point of their sp. processes, and are anchylosed. The examination of younger fish makes this certain. This pair of united ribs forms the support of the anterior interspinous fin bone of the anal fin, which in this case it overlapped, and was attached on the right hand side about $\frac{3}{8}$ of an inch.*

The ventral ends of the last five or six pairs of ribs gradually approach each other until they touch in the last or 33rd pair,

* The sp. processes of the 29th, to and including the 33rd and last pair of ribs, are transversely united, making five abdominal hæmal arches.

producing the beautiful outline of the posterior part of the salmon.

C. 36. On this centrum, (the first of the caudal centra proper), the spinous processes are $1\frac{1}{8}$ inches in length, and attached posteriorly for $\frac{7}{16}$ of an inch is a bone or bones having an extreme divergence from the normal angle, which might be taken for a pair of ribs. The sp. processes, of which mention has been made, are all of the same character as the dorsal and other spinous rays, that is formed of two bones, one springing from each side of the arch and united more or less strongly, as the age of the fish may be. This bone, or if you choose pair of bones are anchylosed and appear as one, their length from the junction with the sp. processes is $2\frac{3}{16}$ of an inch; in the skeleton before you the separation of their ventral ends is a consequence of their dryness. An examination of younger fish will show you that this bone (or bones) originates in a different way from the ribs; looking at this skeleton of what may be called a mature fish, it appears to be a single bone and to have originated and grown from the end of the spinous process, passing and uniting with its next posterior ventral spinous ray having its ventral end attached to the end of the 3rd interspinous fin bone of the anal fin which it slightly overlaps, say $\frac{1}{4}$ inch on the outer or right hand side. In a young fish you will find the spinous processes, but the long bone is merely a short straight bone lying between the processes on the 36th and 37th centra; in the skeleton of the young fish before you the bone does not touch the posterior edge of the 36th sp. process, but is about $\frac{1}{16}$ of one inch from it and it just touches the anterior edge of the spinous process of the 37th centrum, the end of which it does not reach by nearly half an inch; it is therefore most probable that it grows from a centre each way, that is dorsally and ventrally, but that its growth is most rapid towards its ventral extremity.

C. 37. On this centrum (counting the ribs as sp. processes) the 35th ventral sp. ray is attached, and is the first ventral sp. ray having the usual form; it is $1\frac{1}{4}$ inches in length, its ventral anterior extremity is united by cartilage to the bone just mentioned as springing from the end of the 34th sp. process, the great

divergence of which will be perhaps better understood by mentioning that while it lies at an angle of about 14° with the spinal column, the ventral sp. ray springing from this centrum forms its angle about 65°.

C. 38. The spinous ray No. 36 is about $1\frac{3}{4}$ inches long (being a sudden increase of length) and is free—that is, only attached by tissue to the interspinous fin bones of the anal fin. It and the succeeding four spinous rays have wide ventral ends for similar attachment, and are of about equal length.

C. 39. The end of the 37th sp. ray has opposite its point the 4th intersp. bone of the anal fin.

C. 40. The 38th sp. ray has opposite its anterior edge, the 5th intersp. anal fin bone, and opposite its point, the 6th intersp. fin bone.

C. 41. Slightly in front of the 39th sp. ray is the 7th intersp. fin bone, and the 8th is opposite its point.

C. 42. The 40th sp. ray has opposite its centre, the 9th intersp. fin bone; and the dorsal extremity of the 10th and last intersp.

C. 43 fin bone of the anal lies exactly between this and the 41st sp. ray, which is about the same length as the five preceding rays, but its ventral end is somewhat narrower.

C. 44. The 42 sp. ray.
45. " 43 "
46. " 44 "
47. " 45 "
} The ventral extremities of these 4 spinous rays are about the same breadth as the 41st, but the tissue attaching to them, the posterior edge of the 10th intersp. fin bone of the anal, which curves posteriorly, (its ventral end being opposite at right angles to the end of the 44th spinous ray, in order to afford sufficient support), is stronger than that in some other parts of the fish. The total depth of the skeleton at the anterior edge of the anal fin to the edge of the dorsal sp. rays is 5 inches, and at its posterior edge $3\frac{1}{8}$ inches.

C. 48. The 46 sp. ray.
49. " 47 "
50. " 48 "
51. " 49 "
52. " 50 "
} These sp. rays are regular in shape, but their ventral ends are not expanded, they show a gradual decrease in length, which begins from the 41st sp. ray, the 50th ray being $1\frac{1}{8}$ inches long.

C. 53 51. This ray is stronger than those immediately pre-

ceding it. Its breadth is about equal throughout. It has a somewhat blunt ventral end, and it is $1\frac{1}{4}$ inches long; in the slight hollow between this and the 49th sp. ray, is attached the beginning of the caudal muscle which envelopes the short rays of the caudal fin.

C. 54. Opposite the end of the 52 sp. ray begin the short ventral rays of the caudal fin at right angles to the posterior edge of the 56th centrum. The character of the attachment of the ventral sp. rays appears to change with this centrum, their dorsal ends have spread and are in one sense flattened and seem to have an articulated surface as may be noticed by looking at the 52nd, 53rd, 54th, 55th and 56th ventral sp. rays on this skeleton. The posterior edge of this ray (52) is anchylosed with the anterior edge of 53 for about two-thirds of their length from their dorsal towards their ventral extremities.

C. 55. The 53 sp. ray. ⎫ these bones are more or less perfectly
56. " 54 " ⎬ anchylosed, their shapes are so irregular
57. " 55 " ⎭ that only a drawing (which I regret to say I am unable to make) or reference to the skeleton can give you a clear understanding of them.

58—56th sp. ray. This ray is anchylosed on its anterior edge to the 55th sp. ray for about half its length, say $\frac{5}{8}$ of an inch, and on its posterior edge rather more than half its length, say half an inch from its foramina* towards its ventral extremity, to the lower hypural bone; on its ventral end it is free, say $\frac{7}{16}$ of an inch. In shape this ray differs from all the others, at its dorsal end it is somewhat triangular, having a cup-like projection on each side at its junction with its centrum, and its ventral end is included in a cartilaginous rim which passes round the bones forming the termination of the column. This bone, together with the two saddle bones on the dorsal aspect of the spine, appear to me to be the representatives of the pelvic bones in mammals.

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* The foramina in this bone are for the passage of the blood vessels. The superior in this specimen passes to the left, the inferior to the right side, each opening into a sack or sinus having a communicating foramen which lies between the first lower and second lower hypural bones There is also a foramen at the junction of this bone with the anterior edge of the lower hypural in this specimen, of considerable size, in others smaller in proportion.

59–$\frac{1}{\text{H}}$. To this vertebral centrum is attached the lower hypural bone, which has a somewhat narrow neck, caused by a foramen on its anterior edge, which passes between it and the ray on the 58th centrum, and a double foramen passing between the posterior edge of this hypural bone and the anterior edge of the second; this double foramen appears to be for the passage of vessels uniting the (pulsating?) sacks. Also attached to this centrum is the second hypural bone; it is notched on its ventral anterior surface by the foramen above mentioned, the division of which is nearly parallel with the centrum; this division is caused by a slight projection in the centre of the foramen on this, as well as on the bone already described. At the posterior extremities the adjacent faces of the above two bones are partially rounded, that is, their adjoining corners are rounded off, and in the hollow thus formed, which is slightly above a line drawn through the centre of the spinal column, is a nervous corpuscle, so shrunken in this skeleton as now to be scarcely observed, but when fresh, it measured three sixteenths of an inch in diameter. This corpuscle projects slightly beyond the edge of the hypural bones.
60. Attached to the ventral surface of a spongy centrum is the third hypural bone, and to its end, if indeed it does not belong to it, is attached the fourth hypural bone, terminating the sixty centra of the spinal column. We have therefore four hypural bones, which being strongly connected together as well as to the posterior ventral rays, form a broad solid plate for the attachment of the muscles, and the strengthening of the rays of the caudal fin. The bone lying next above this is the larger Y shaped bone, the notochord passes between the forks of this bone as in the smaller bone of similar shape.

Prof. Huxley's drawing, representing the tail of the *Salmo* published in his "Manual of the Anatomy of Vertebrated Animals," page 20, is incorrect if the *Salmo* of England are the same as ours. He makes the vertebral column in this drawing to end in a line common to the anterior vertebræ, and at the end of the last centrum which is drawn of greater diameter than those which precede it, is attached at an angle nearly equal to that formed by the posterior part of the spinal column in the skeleton before you, a terminating bony plate,

and to the ventral edge of this are attached *two* hypural bones. There are also some other bones which do not correspond to some in our *salmo*. On page 131 of the same work he says, "the spinal "column appearing to terminate in the centre of a wedge-shaped "hypural bone, to the free edges of which the caudal fin rays are "attached, so as to form an upper and a lower lobe, which are "equal or sub-equal. This characteristically Teleostean structure "of the tail-fin has been termed homocercal—a name which may "be retained, though it originated in a misconception of the re-"lation of this structure to the heterocercal condition."

The caudal fin-rays in my specimen are not attached to the "free edges of the hypural bones," but their divided ends overlap the hypural bones on each side; on the dorsal part about five-eighths of an inch; a quarter of an inch on the central, and from a quarter to half an inch on the inferior or ventral part. In the drawing referred to one of the fin-rays is inserted in a notch in the posterior edge of the upper hypural bone, nearly in the place where the corpuscle already mentioned should be.

Transverse Proccsses.

The transverse processes are attached directly to the centra, and begin on the 1st centrum. The first four are nearly at right angles to the column, and project posteriorly into the fleshy tissue, and are say $\begin{array}{cccc} 1 & 2 & 3 & 4 \\ \hline 1\frac{1}{4}, & 1\frac{1}{2}, & 1, & 1\frac{1}{8} \end{array}$ inches in length, from 4 to 25, their outer extremities rising gradually towards the dorsal line. They are of variable length, 1 to $1\frac{1}{2}$ inches, not gradually decreasing, but some long, others shorter—including 26 to 32, they rise rapidly towards the dorsal line, so that their dorsal ends are near to the spinous rays; all the transverse processes arise from their centra posterior to their corresponding ray. Besides the transverse processes enumerated, which are bony, there are some that appear to be attached by tissue to their centra, having soft bony extremities: these have their attachment gradually rising on the dorsal spinous rays, but soon they lose their bony texture, and appear only as threads attached to the muscular tissue.

Dorsal Fin.

The dorsal spinous rays make an angle with the spinal column (speaking generally) of from 35 to 42 degrees, and the first interspinous fin-bone of the dorsal fin consists of three bones anchylosed, appearing at the articulation of the dorsal fin ray as one bone expanding into three. The anterior edge of these bones has a somewhat broad face, three-sixteenths of an inch at its widest part, and it is seven-eighths of an inch in length; from the dorsal end of $\frac{1}{14}$ interspinous bone, springs a very strong fibrous attachment, embracing the inserted ends of the triple intersp. fin bone; it then passes downward and is strongly attached to the end of the 4th intersp. fin bone, (counting the short bones above mentioned, as three), which is the first long intersp. fin bone of the dorsal fin. This bone is slightly in front of the 16th spinous ray, which has no extra interspinous bone. The 16th sp. ray is a little less in length than 15, and from it, to and including the 25th ray, a gradual curve is formed by the extremities of the dorsal spinous rays for the insertion of the dorsal fin and its appendages.*

1st intersp. fin bone,			$\frac{7}{8}$ in length.		these 3 bones anchylosed.
2	"	"	" 1	"	
3	"	"	" $1\frac{3}{8}$	"	

4 intersp. fin bones, is $2\frac{11}{16}$ inches in length, and forms an angle of 42 degrees with the vertebral column, while the sp. ray (16) to which it is opposite makes an angle of 35 degrees.

5 intersp. fin bone $2\frac{5}{8}$ inches lies between the points of 16 & 17 sp. rays, angle 40 degrees.

6 intersp. fin bone			$2\frac{1}{2}$	between 17 & 18, angle 43 degrees.
7	"	"	" $2\frac{1}{8}$	slightly in front of 19, angle 54 degrees.
8	"	"	" 2	between 19 & 20, angle 55 degrees.
9	"	"	" $1\frac{7}{8}$	slightly in advance of 21, angle 55 degrees.
10	"	"	" $1\frac{3}{4}$	slightly in front, of 22, angle 55 degrees.
11	"	"	" $1\frac{3}{4}$	between 22 & 23, angle 56 degrees.
12	"	"	" $1\frac{5}{8}$	slightly in front of 24, angle 55 degrees.
13	"	"	" $1\frac{5}{8}$	opposite the point of 24, angle 52 degrees.
14	"	"	" $1\frac{5}{8}$	slightly in front of 25, angle 51 degrees.

*This is much more apparent in the skeleton of the young Salmon.

15 and last intersp. fin bone is $1\frac{1}{2}$ inches in length. It has a prolongation posteriorly for the attachment of the last single together with the double fin ray, and also for the strong fibrous attachment which connects it with the dorsal muscle.

The fin-rays of the dorsal fin are in number 15. By some they would be counted as 14, but further on I will give the reason for counting them as 15.

1st Ray. This ray is so small as to be easily overlooked in young specimens. In this one from its root or articulation with its intersp. bone it is five-sixteenths of an inch in length: the point of it reaches only through the skin, but it is a true ray, having its bony regular articulation just above the anterior face of the short one of the triple bone.

2nd ray. The second ray is five-eighths of an inch, and

3rd ray. the third ray is one and three-eighth inches in length, these first three rays are covered or as it were included in the integument as one ray.

4. The fourth, or first ray having its full length, is three and seven-eighth inches from articulation to point; divided at its ventral extremity to form its articulation on each side of the interspinous bone, as are all the fin-rays.

5 to 10. are all of the same type gradually decreasing in length to ten, which measures two and three-eighth inches.

11. The eleventh ray is two and one-eighth inches.

12. The twelfth ray is one and seven-eighth inches.

13. The thirteenth ray is one and five-eighth inches.

14 & 15. Although apparently so closely united, 14 & 15 are separate fin-rays, having each an articulation, that is, the 15th ray is set within the 14th. They are attached as before stated to the posterior extremity of the 15th intersp. fin bone, and if the first three short rays are to be counted, then should these rays be counted as two, for though they are articulated to one base, yet each is a complete ray.

The height of the interspinous bones of the dorsal fin, to the junction of its fin-rays, from the centre of the vertebræ at right angles to the anterior edge of the fin, is three and a half inches; at the posterior edge, three and a quarter inches; length of dorsal

fin from anterior to posterior edge, (rays only) three and three-quarter inches, and including the end of the last interspinous bone four and a quarter inches.

Adipose Fin.

Of the adipose fin there is little to say. Its anterior edge is opposite the posterior edge of the base of the anal fin, it has no attachment through the dorsal muscle to the general muscular tissue. It appears to be an expansion of the integument, and has its base in the cord of the dorsal muscle, which is somewhat thickened and of firmer structure, (more like a cord), where it appears, more so anteriorly than posteriorly. There does not appear to be in it anything which can be called a fin-ray. I have examined a number of *S. salar* as well as S. *canadensis*, with a good glass without discovering any trace of what might be termed a ray, but I cannot say that the microscope would not bring them to view. The only difference observed by me is that while most are smooth and rounded off at the dorsal edge, some present a few of what might be termed raylets, forming a delicate feathered edge.

Caudal Fins.

At the point of the 54th spinous ray begins the upper or dorsal portion of the muscle of the tail rays: this beginning of the caudal fin, which is enveloped by the muscle consists of eleven short rays or spines, filling in and giving to the tail as a whole its line of beauty, strengthened by the anchylosed dorsal sp. rays, and adding to the propelling power of the tail. These short rays are all divided at their anterior ends (or V shaped) united on each side to the general structure, presenting at the dorsal edges the appearance of single rays.

1–4. 1–4 are short and straight.

5–6. 5–6 are somewhat curved, the 6th more pointed at its outer extremity than the 5th.

7. 7 is single at its insertion and divided into two rays at its extremity, and from its division to outer end somewhat curved and pointed.

8 & 9. The 8th & 9th are single at their insertion as well as at their dorsal ends. 9 is one and a half inches long.

10. The 10th short ray is nearly straight. Between ten and eleven, attached to the upper edge of the 11th short fin-ray, at about $1\frac{1}{2}$ inches from its inferior end is an extra bone $\frac{9}{16}$ of an inch in length.

11. This ray is nearly straight, curving at its outer end to follow the shape of the long rays; it has a very thin pointed ventral end; its length is two and a half inches.

The first short fin-ray is about $\frac{5}{16}$ of an inch long.

The eleventh short fin-ray is about two and a half inches long.

The caudal fin has nineteen long or perfect rays, (their insertion in this specimen will average about one inch in length,) which begin to divide or split up into a great number of fin rays, shortly after the exit of the tail from its root or body of the fish. The first and second rays counting from the dorsal region are exactly opposite to the centre of the elevation of the spinal column, so that there are seventeen whole rays beneath it.

1 to 8. The first eight rays are closely united by strong fatty tissue to their emergence from the integument.

8 to 9. Between the inferior ends of eight and nine there is a space of irregular outline filled with fatty tissue which extends some distance between these rays, at its widest part it measures $\frac{3}{16}$ of an inch.

9 & 10. The inferior extremities of these rays meet for $\frac{3}{8}$ of an inch and are then separated for about $\frac{5}{8}$ of an inch.*

10 & 11. Are separated at their emergent ends.

11 & 12. do. do. do.

The 9th, 10th, 11th & 12th rays are broader on their inserted ends by cartilaginous matter, than are the other rays.

12 & 13. The inserted ends of 12 and 13 join for about a quarter of an inch, but are then widely separate, and the ray thirteen is inserted into the root of the tail an eighth of an inch more than twelve.

All the spaces enumerated above, beginning between eight and nine and continuing to that between twelve and thirteen extend into the tail proper as a sort of web by which the tail may be expanded and contracted in its width.

* 10th ray.—A line drawn through the centre of the spinal column touches this ray, the centre ray of the caudal fin.

13 & 14. Are close together to the beginning of the tail proper.
14 & 15. Are close at their inserted ends, slowly separating until divided for the expanse of the tail, when they appear as close together.
15 & 16. Almost unite for one inch, they then appear as slightly separate.
16 & 17. Inserted ends close, then very slight separation.
17 & 18. Same as above.
18 & 19. Close together, nineteen being the ventral ray. The first three outer rays of both aspects of the caudal fin, dorsal and ventral are very strong.

The short rays of the caudal fin on the ventral side beginning at the end of the fifty-fourth spinous ray, are eleven in number

1st. This short ray which is next the nineteenth caudal ray proper, is $2\frac{1}{2}$ inches long.

2nd. The second short ray is 2 inches long.

} these two are nearly straight and pointed at either end.

3rd. The third short ray is $1\frac{3}{4}$ inches long; pointed and slightly curved laterally.

4th. The fourth short ray is $1\frac{1}{16}$ inches long; more curved laterally than the third.

5th. The fifth short ray is 1 inch long; slightly curved.

6th to 11th. These are all curved more or less, and the eleventh is a quarter of an inch long. The points of these short rays are united as the spinous rays, and enveloped as the dorsal short fin-rays by the tail muscle; they have a little more separation than the dorsal short fin-rays, and are deeper than their breadth.

Anal fin.

The anal fin begins, or rather the anterior end of the first intersp. fin bone is attached, as before stated, to the end of the 33rd pair of ribs (on the 35 centrum). This intersp. bone is $2\frac{5}{8}$ inches long, and has upon its ventral anterior surface a heart-shaped shield, half an inch wide at its dorsal edge, and in depth $\frac{5}{8}$ of an inch, which is attached by cartilage to the intersp. fin bone. On the lower face of this shield or plate is a short cartilaginous ray, (half an inch long) having a bony base. It has no articulation

but cartilaginous matter between it and its suspending plate. This soft ray is so closely covered with fatty tissue as scarcely to be noticed unless by dissection.

1st ray. Directly in a line with the first intersp. fin bone is the first short fin-ray, which (as do all the remaining fin-rays) divides at a short distance from its articulation with the intersp. fin bone, one half passing to each side of it, the foot shaped joint pointing posteriorly being comparatively shorter than the others. The length of this ray is $1\frac{1}{8}$ inches, and its anterior face is attached by tough fatty tissue to the rudimentary ray first described.

2nd. The second short fin-ray is directly opposite, and attached to the end of the second intersp. fin bone, shaped like the first. It is $1\frac{3}{4}$ inches long.

3rd. The third or first perfect fin-ray is attached to the anterior edge of the third intersp. fin bone, and this in its turn is attached to the end of the peculiar spine, which springs from the thirty-sixth centrum, and to which as before noticed the end of the thirty-fifth ventral sp. ray is united. And here it would seem that as this is the first perfect or full length fin-ray of the Anal, some provision was required to add to its strength, which is attained by the junction of the thirty-fifth spinous ray with this long slight bone. The thirty-sixth sp. ray being directly between the third and fourth intersp. bones, leaves a space rather more than one-fourth of an inch in width and thereby changes the angle of the remaining intersp. fin bones. Thus the general angle formed by the first intersp, fin bone with the spinal column, which intersp. fin bone is attached to the thirty-third pair of ribs, is thirty degrees, while that formed by the fourth intersp. bone is thirty-seven degrees.

4th. The fourth fin-ray is attached to the centre of the fourth intersp. fin bone.

$$\left.\begin{array}{ll} \textit{5th.} & \text{Same attachment to five.} \\ \textit{6th.} & \text{“ \quad “ \quad “ six.} \\ \textit{7th.} & \text{“ \quad “ \quad “ seven.} \end{array}\right\} \text{intersp. fin bones.}$$

The 3rd, 4th, 5th, 6th and 7th fin-rays are thicker than the others.

8th. The eighth fin-ray is not so strong as its anterior five rays,

and is attached to the eighth intersp. fin bone. As the length of the rays of the anal decrease so does their strength, but much more in proportion in this and the remainder of the rays.

9th. The ninth fin ray is on the 9th intersp. fin bone, which is slighter in proportion than the 8th or 10th intersp. fin bones. The tenth intersp. fin bone, the end of which lies between the 41st and 42nd spinous rays, with its posterior ventral extremity opposite at right angles to the end of the 44 sp. ray, is, as will be noticed by you, differently shaped from all the other intersp. fin bones of this fin, (somewhat resembling the posterior intersp. fin bone of the dorsal fin) having a strong posterior curve at its ventral extremity, and an increase in breadth, presenting a broad face (or end) for the articulation of three fin rays, counting, as on the dorsal fin and for the same reason, the last rays as two. Its extreme posterior edge is furnished with the usual attachment for the muscular tissue which supports the posterior edge of the fin.

10th. The tenth fin-ray is attached to the anterior edge of the tenth intersp. fin bone, which as just noticed has a slight projection for its articulation.

11th & 12th. These two fin-rays lie closely together, but as they have a double articulation, (as the two on the dorsal fin,) they clearly must be called two distinct rays. They are also (as in the dorsal) articulated one within the other, and attached to a slight depression closely in front of the posterior edge of the tenth interspinous fin bone.

Mem.—1 intersp. fin bone $2\frac{5}{8}$ inches long.

2	"	"	"	$2\frac{5}{8}$	"	"
3	"	"	"	$2\frac{1}{2}$	"	"
4	"	"	"	$2\frac{1}{8}$	"	"
5	"	"	"	$2\frac{1}{16}$	"	"
6	"	"	"	2	"	"
7	"	"	"	$1\frac{7}{8}$	"	"
8	"	"	"	$1\frac{3}{4}$	"	"
9	"	"	"	$1\frac{5}{8}$	"	"

10 " " " $1\frac{3}{4}$ inches long to depression for attachment of the eleventh and twelfth fin rays.

1–5. The 1st, 2nd, 3rd, 4th and 5th fin-rays are slightly separated from each other.

5 & 6. Between 5 and 6 there is nearly $\frac{1}{8}$ inch of space.

6 & 7. Between 6 and 7 a little more, say $\frac{1}{8}$ inch of space.

7 & 8. Between 7 and 8 a little more than $\frac{1}{8}$ inch of space.

8 & 9. Between 8 and 9 a full $\frac{1}{4}$ of an inch of space, just below their articulation.

9 & 10. Between 9 and 10 not quite $\frac{1}{4}$ of an inch of space.

10 & 11. Between 10 and 11 just perceptibly more than between nine and ten.

11 & 12. touch but are not united, and are therefore separate rays.

Ventral Fins.

These fins are attached to two bones which are imbedded in the strong fatty muscular tissue in the belly of the fish. They appear on its surface opposite at right angles to the 12th dorsal ray, and are attached to the two bones already referred to, commonly called the pelvic bones, which in this specimen are $3\frac{1}{4}$ inches in length, measured from the centre of the left bone to its point or termination of its junction with the bone of the right side to which it is united* by cartilage, forming a somewhat rounded termination. For convenience I will take one, the left of these bones. You will notice at once its peculiar shape, its posterior end has a stout transverse ridge; extending and springing from this laterally on its outer edge is a ridge increasing a little in size until it is about $\frac{1}{8}$ of an inch in thickness, rounded on its dorsal aspect and projecting rather more than $\frac{1}{16}$ of an inch above a thin bony plate $\frac{5}{8}$ of an inch in breadth at its posterior extremity; decreasing anteriorly to a point which is united to the transverse ridge as far as its inner end, and extending along the lateral ridge two inches, this lateral ridge being prolonged anteriorly $\frac{3}{4}$ of an inch beyond the thin plate or blade. On the ventral aspect the plate or blade rises, following the curve of the lateral ridge which in consequence does not show any abrupt projection. The posterior end of the bone or transverse ridge is, in this specimen, one inch in breadth, and to it the

*In young specimens they can scarcely be said to be united.

fin-rays are attached. The outer head of the transverse ridge projects a little beyond the lateral ridge, the space so formed being filled with cartilaginous matter from which springs ligamentous attachment running some distance along and tying this bone with the muscles of the belly. On the inner edge of the bony blade and attached to the cartilage on its anterior edge, strong fibrous tissue passes enveloping the blade as well as the anterior ends of the lateral ridge, from thence passing to the general muscular tissue. A similar attachment passes posteriorly from the cartilage between the pelvic bones, having attachment to the inner ends of their transverse ridges, with divergent connections to the integument covering the rays immediately under the point where the inner fin-rays appear upon the surface of the fish, from thence continuing some distance as a strong band down the centre of the belly. The pelvic bones are not always parallel with a line drawn through the centre of the belly, but are occasionally somewhat distorted, that is each forming a different angle with such central line.

The ribs from and including No. 15 & 22 are shorter in proportion than the others; this is in order to allow for the insertion of the pelvic bones, thus preserving the line of beauty. The space so afforded by the shortening of these ribs is 4 inches in length; (that is from the end of 14 to 22,) the length of the pelvic bones being $3\frac{1}{4}$ inches, and from them to the extreme posterior end of the long fin-ray is $3\frac{3}{4}$ inches, making a total length of the fins and their attachments $6\frac{5}{8}$ inches average, allowing for the overlapping of the fin-rays upon the pelvic bones. It must however be borne in mind that the fin-rays owing to their curves, are of eccentric lengths, there being a difference in the measurements as they are taken from the dorsal or ventral aspects; in the lengths above I have taken the dorsal aspect in a straight line (not round the curve of the ray), the measurement of the ventral aspect of the same ray is $3\frac{1}{2}$ inches.

The ventral fins each contain 9 rays and each fin has a ventral appendage, in this case they are $1\frac{1}{2}$ inches in length.

1st. The first or outer ray divides at $1\frac{1}{4}$ inches from its attachment to the pelvic bones (that is visibly); on its ventral aspect it is at-

tached to the pelvic bones by fibrous tissue and has a curved termination: on the dorsal aspect it curves strongly, forming a double heel each $\frac{3}{8}$ of an inch in length. The dorsal aspect is strongly attached by fibrous tissue to the outer head of the pelvic bone; and the inner heel is also embraced in similar attachment, together with the flat bony root of the ventral appendage ("axillary scale" of Dr. Gilpin,) from the outer side of which passes a muscle into the general muscular tissue. From the outer heel a strong muscle is attached passing in the same way. It may here be mentioned that there is a strong band of muscular fibre passing forward from the ventral appendage, which, with its other muscular attachments, causes these appendages, when the ventral fins are in motion, to pass under them so as to protect the hollow which appears at the root of the ventral fin, preventing the lodgment of any floating material, such as sawdust or chips in what must be a sensitive part. As soon as the ventral fins are at rest these appendages withdraw themselves and lie parallel with their outer edge.

Dorsal aspect ventral:

1st.	The	first	ray	measured in a straight line from heel	to extremity	is	$3\frac{1}{2}$	inches in length.
2nd.	"	second	"	"	"	"	$3\frac{1}{2}$	" "
3rd.	"	third	"	"	"	"	$3\frac{1}{4}$	" "
4th.	"	fourth	"	"	"	"	3	" "
5th.	"	fifth	"	"	"	"	$2\frac{3}{4}$	" "
6th.	"	sixth	"	"	"	"	$2\frac{1}{2}$	" "
7th.	"	seventh	"	"	"	"	$2\frac{1}{8}$	" "
crowded.								
8th.	"	eighth	"	"	"	"	$2\frac{1}{8}$	" "

The heel of the eighth is not like those of the previously mentioned rays, as its anterior end is very slightly raised towards the dorsal aspect, and slightly curved in opposition to the heels of the other rays; it passes very close to, and almost under the heel of No. 7 and near to the pelvic bone.

9th. The ninth ray has no heel on the dorsal side, but it has a slight upward curve in its line of direction tending towards the other rays, its length is $1\frac{3}{4}$ inches, its anterior extremity passes

also close to the heel of No. 7 giving a crowded appearance to the last three rays, which are attached by strong fibrous tissue to the dorsal side of the inner ventral heel or broad plate of No. 9, which is turned inwards towards the outer side of the fin in opposition to the heels of the other rays, (it being the only ray having this peculiar form); this broad plate is in its turn attached to the stout transverse process of the pelvic bone upon which its ventral surface moves ; in addition to this broad plate it has upon the ventral side the usual termination. The rays No. 2, to and including 8 are nearly of the same shape.

Ventral aspect, Ventral fin.

Here the rays, may, at their anterior ends be said all to curve towards the centre of the fish.

1st ray. The curve of the first ray fits upon the ventral aspect of the enlargement or head of the outer edge of the pelvic bone, having very strong ligamentous attachment.

2nd. The second has the same attachment, its curved end terminating on the inner edge of the ventral aspect of the outer head of the pelvic bone.

3–9. The remaining rays have all a similar attachment, their anterior curves becoming less, until No. 9 is almost straight, and the ends of all gradually receding.

The dorsal heel of the 2nd ray is opposite to its ventral extremity, but the other rays gradually recede on the dorsal side until the anterior extremity of the 9th ray ventral aspect is one quarter of an inch in advance of the dorsal side of the same ray.

When the ventral fins are in motion or extended, all the anterior ends of the fin-rays appear closely crowded together, more so on the ventral than upon the dorsal aspect.

You may perhaps remember that in describing to you the dorsal aspect of the spinal column, your attention was drawn to two bones lying above the 57th centrum, covering it together with the 58 and 59th and partially that which may be called the 60th centrum, leaving on the dorsal aspect three centra unprovided with spinous processes ; on the ventral aspect your attention was also directed to a conical process different from all the other spinous processes which I said together represent in my view the

pelvic bones. The bony plates to which are attached the ventral fins, together with the fins are usually called the pelvic limbs, but it appears to me there can be little doubt that the so called pelvic bones with the fins are the representatives of the hind legs of mammals, thus:

The saddle bones and the bone with the cup shaped orifices below them, are the pelvic bones.

The centra without spinous processes, the sacral vertebræ.

The large hypural bone, the femur.

The pelvic bones, or the bony plates to which the fins are attached; the tibia and fibula and the ventral fins generally the feet.

The Shoulder girdle and Pectoral fins.

At the junction of the body with the head under the opercular plate, appears on each side of the fish a series of bones forming the fore frame and support of its body, and from which spring at about two-thirds of their total length the pectoral fins. In the specimen of the salmon before you on their outer sides each set appears primarily to be formed of three bones. Reversing these bones and looking at their inner surfaces there appears to be on each division (right and left side) another bone now anchylosed with the posterior edges of each middle bone or inter-clavicle, and throwing off from their anterior edges a thin process or plate, which passes partially over the lower edges of the supra-clavicles and united to the anterior edge of each of the inter-clavicles, serving as a base for the supra-clavicles and for the attachment of their tissues.

Taking, as in the ventral fins, the shoulder-girdle, left side—removed from the body of the fish, the upper portion the supra-clavicle viewed from the outside has a two-fold* termination, the posterior fork passes freely, apparently without any ligamentous† attachment, into the fleshy tissue; measured in a direct line from base to point it is $2\frac{1}{4}$ inches in length, and its base is a little less than $\frac{5}{8}$ of an inch in breadth. It overlaps the inter-clavicle; at $\frac{5}{8}$ of an inch from its base, anteriorly, arises

*Three-fold, if looked upon as the same bones in the cod are usually accepted.

†I could not find any in three specimen .

another process having a cartilaginous attachment to it, this process is somewhat irregular in shape and rough upon its edges for the attachment of the tissue which unites it to the bones of the skull. It penetrates beyond the marginal point of the pre-operculum and its tissues are connected with the edge of the supporting bone above the fleshy cheek behind the eye, in shape it is nearly straight, slightly curved laterally; from its junction with the supra-clavicle to its point it is about $1\frac{7}{8}$ inches in length; on the anterior edge of its projection or root this small bone is attached by cartilage to the bone which supports the operculum. To enable you to understand this junction I have cut off a small portion of bone from the skull leaving the cartilage entire. Let us turn this bone over and look at its inner face, at the point of junction of the small bone already noticed as supporting the upper portion of the supra-clavicle and diverging from it dorsally in a line with the centre of the root of the small or supra-clavicular bone is a *short* bone having a very strong ligament connecting it with the skull bone at the base of the brain, (it is this short bone which makes in the Cod fish the forked supra-clavicular bone, but it differs from the salmon inasmuch as it is throughout a bone and is not a representative of the process in the salmon which springs from the supra-clavicle,) a pin in the skull of the large skeleton marks the point of connection.

Of the middle piece or inter-clavicle there need not much be said, it is as the supra-clavicle thin and flat and its upper end is inserted under the edge of the supra-clavicle, on its anterior face for nearly $\frac{5}{8}$ of an inch, posteriorly it has a thickened striated edge; its lower extremity which is flat, thin and oval shaped overlaps and is attached to the clavicle, presenting the appearance of nearly concentric plates, the growth of which has taken place apparently from the inner side. In specimens freshly taken this bone has considerable freedom of motion upon the clavicle.

The Clavicle, Coracoid, Scapula, &c.

It is almost impossible for me to describe the shape of the clavicle and the bones connected with it, but I will make the attempt.

The clavicle from its inferior edge to the extremity of its anterior horn is in this specimen:—$2\frac{3}{4}$ inches in height; $3\frac{3}{4}$ inches in length, from posterior to anterior end, and measured on a line through its centre; the inter-clavicle is attached to it for about $1\frac{1}{4}$ inches, measured from the top of its anterior horn, and the shape of its superior extremity nearly corresponds to that of the inferior extremity of the inter-clavicle; on its inner side, near its posterior edge, there is slightly projecting from it a thin bony plate, terminating at the lower edge of the clavicle to which it is anchylosed, it has a narrow rounded end, this unites with the posterior edge of the accessary bone—its lower rounded end is close to it. The accessary bone arises about midway on the posterior edge of the clavicle, at the junction of the division of its thin posterior plates, and is anchylosed with it; it becomes gradually thicker for nearly one-third of its length and then decreases to its inferior end where it has the usual enlargement for its attachment to the strong muscular tissue in this part of the fish, its interior edge projects $1\frac{1}{8}$ inches below the clavicle, and its posterior edge $\frac{7}{8}$ of an inch. This accessary bone passes inside of the pectoral fin, and gives support to it; it is entirely different from that of the cod-fish in shape as well as attachment. In the cod, as you will see by the specimen (pectoral fin, clavicle, etc., shown), it is a free bone, lying loosely upon the upper posterior edge of the clavicle.

The scapula joins at its superior extremity the upper edge of the clavicle, and its inferior extremity the upper posterior division of the coracoid bone; its posterior inferior extremity is also attached by cartilage to the posterior edge of the bones, which represent the radius and ulna.

The coracoid at its posterior extremity is divided. Its upper edge is united with the scapula, as already mentioned; its lower limb, which is the longest, has its point attached to the inner central ridge of the clavicle, and it is pierced by two foramina, each of considerable size, one on either edge, outer and inner, the latter being the largest and oval in shape; the posterior edge of this lower limb is united by a band of very thin bone, which follows on the one side its shape, and on the other the outline of

the two nearly circular bones which represent the radius and ulna. The anterior extremity of the coracoid is somewhat twisted, that is, its inner and superior edge rises for its union by cartilage with the clavicle, which sends out from its central ridge a flat process for this purpose.

The Humerus.

If you will look at the under side of the coracoid bone, which on this aspect appears to be nearly flat and somewhat curved, from its posterior extremity to its junction with the clavicle; between the foramina already noticed you will perceive a central ridge, which expands towards its posterior extremity; about midway of its length there appears to be a transverse joining, or symphysis, and following this ridge posteriorly you will see that one edge of it forms the outer side of the inner foramen, and that there is a line or indentation which passes by the edge of the outer foramen to the transverse division from whence we started, this appears to me to be, without doubt, the humerus, but to be positive on this point requires the examination of very young specimens of the salmon, which I regret to say my sight will not permit me to undertake.

Carpal Bones and Pectoral Fin.

The pectoral fin is attached to four ossicles, or carpal bones, with the exception of the upper or long ray, which is directly articulated with the radius—the upper one of these ossicles and the shortest is attached to the ulna; the three lower to the posterior extremity of the coracoid, at the lower part of the bone which I regard as the humerus—all cartilaginously. The lower ossicle is $\frac{3}{4}$, the upper about $\frac{5}{16}$ of an inch in length.

The rays of the pectoral fin are fourteen in number. The first or upper ray is in length, from attachment to posterior extremity or point, $4\frac{3}{8}$ inches, the others gradually decreasing in length until the lowest and shortest is $1\frac{3}{8}$ inches. Looking at the fin on either side the rays are crowded, and set one within the other after the manner of a venetian blind when turned to keep out the rays of the sun, the inner inferior margin being the lowest. The upper or long ray, at its attached extremity is very much stronger than the others, and at this point it

has a wide articulating surface on its inner side or heel for its union with the radius upon which it moves, this surface is furnished with the usual lining and ligaments of such joints; from its inner to outer heel transversely it is in breadth $\frac{5}{8}$ of an inch.

Outer side of the pectoral fin.—The heel of the first or upper ray is $\frac{3}{8}$ of an inch in length, and nearly at right angles to its shaft, the heel inclining away from its supporting bone, and at the same time turned towards the ventral aspect of the fish. The heels of the remaining rays gradually increase their angles or have less abrupt curves until the last two or three rays, when their curves again become sharper, the lengths of all decreasing, but the outer heel of the lowest or short ray preserves nearly the normal shape, and projects an $\frac{1}{8}$ of an inch below the supporting ossicle. On its inner side the heel of the long ray is very stout, and its edge inclining downwards gives it a broad termination for the accommodation of the articular joint. The heels of the next six rays gradually decrease in their length and curves until the 8th ray is nearly straight; the 9th, 10th, 11th, 12th and 13th rays are also nearly straight, but closely crowded together, and the inner heel of the 14th is curved upward and almost overlaps the end of No. 13; the outer heel of 14 is, from outside to outside, $\frac{1}{4}$ of an inch below the inner extremity. All the rays are on each side attached to the base of the fin, by strong cartilage, which fills the division of or the space between the rays, so much so that without destroying the fin, which at present cannot be spared, it is impossible for me to give a more particular description of it.

At the junction of the clavicles, which are connected by cartilage and closely attached to their united ends by strong fatty tissue, is the urohyal bone, in this specimen it is $1\frac{3}{4}$ inches in length, and $\frac{3}{4}$ of an inch in height at its posterior extremity; at this point begins its ventral transverse plate, for half an inch of its length it is very narrow, but it rapidly widens until it attains $\frac{3}{8}$ of an inch, taking a lanciolate form. This bone is perpendicular to the body of the fish, and by its anterior end it is attached to the hyoid bones.

This brings us now to the head of the fish on the ventral

aspect, and my present task is done. I have endeavored to describe to you the bones of the salmon (*Salmo-Salar*) as they appear to me to be. I have no theory to advance or support, and it is too much to expect that in what I have read to you there is no error, but it may serve to help some enquirer on his way, and if such be the result my time will not have been spent in vain.

(*For Figures see Appendix.*)

ART. VIII.—NOVA SCOTIAN FUNGI. BY J. SOMMERS, M. D.

(*Read Jan: 26, '80.*)

THE present paper affords a very short list of some of the more common species of our mycological flora, the result of a three months' study of a local botanical region.

During the time very many specimens have passed through our hands. Difficulties in diagnosis, want of sufficient time, and the evanescent characters of many of them, have been important factors in determining the length of our list, but we have observed enough to convince us that the fungi are capable of affording a field for study which will take many years of patient and laborious investigation to render complete.

Viewed either from scientific or economic point, the fungi furnish us with interesting matter for study and comparison. Their organization, growth and reproduction afford matter for originality in their treatment by scientists. Their medical and nutritive properties—their parasitical and destructive tendencies supply matter for reflection on the part of the economist.

To the student of nature they are of interest, as situate on the border line between the dead and living things of earth—maintaining the balance of power, devourers of dead organic matter, destroyers of decaying organisms; they supply, also, a bountiful store for hosts of highly vitalized, organized beings, and are not even disdained by man himself.

The local peculiarities of our Province now existing, viz., its dense woods and extensive swampy barrens, furnish favorable conditions for the development of this class of vegetables, which our dry atmosphere would, under other conditions, seriously interfere

with. The progress of arts and agriculture in the future, will with them, as in the case of our higher indigenous plants, cause their disappearance, the present is therefore the time to classify them and record their existence.

ORD. I.—AGARACINI.

SERIES—Leucospori.

SUB. GEN.—Amanita.

1. Agaricus (Amanita) vaginatus, *Bull.* Under hemlock and pine, N. W. A., Hx. Sept.

2. Agaricus (Amanita) adnatus, *Smith.* Under spruce; Point Pleasant, Hx. Sept.

3. Agaricus (Amanita) muscarius L. Not uncommon in same situation as above. September and October. Poisonous.

SUB. GEN.—Tricholoma, Fr.

4. Agaricus (Tricholoma) columbetta, *Fr.* Park woods; under spruce. Oct.

5. Agaricus (Tricholoma) crassifolius, *Berk.* Under spruce; Park woods. Oct.

SUB. GEN.—Clitocybe, *Fr.*

6. Agaricus (Clytocybe) laccatus, *Scop.* Common in most situations. Aug. to Oct.

SUB. GEN.—Colybia, *Fries.*

7. Agaricus (Collybia) dryophilus, *Bull.* Point Pl. Park, Hx. Oct.; on decaying leaves, etc.

SERIES—Dermini, *Fr.*

SUB. GEN.—Naucoria, *Fr.*

8. Agaricus (Naucoria) nuceus, *Bolt.* In the Park woods; under spruce fir. Oct.

9. Agaricus (Naucoria) pediades, *Fr.* In open spaces. Oct.

SUB. GEN.—Galera, *Fr.*

9. Agaricus (Galera) ovalis, *Fr.* On cattle droppings in woods. Nov.

SERIES—Pratellæ, *Fr.*

SPORES—Purple or intense Brown.

SUB. GEN.—Psalliota, *Fr.*

10. Agaricus (Psalliota) campestris, *L.* Everywhere in cultivated land, and pastures. Common mushroom.

SUB. GEN.—Pilosace, *Fries.*

11. Agaricus (Pilosace) eximius? *Peck.* On a decaying log; the Dingle, N. W. A., Hx. Sept.

SERIES—Coprinarii, *Fr.;* Spores Black.

SUB. GEN.—Psathyrella, *Fr.*

12. Agaricus (Psathyrella) gracilis, *Fr.* On cow droppings. Sept. In pasture; Dutch Village.

GENUS—Coprinus, *Fries.*

13. Coprinus micaceous, *Fr.* Common on dung and compost Aug., Nov.

GENUS—Cortinarious, *Fr.*

SUB. GEN.—Dermocybe, *Fr.*

14. Cortinarious (Dermocybe) cinnamomeus, *Fr.* In grassy spaces in the Park, Hx. Sept.

GENUS—Lepista, *Smith.*

15. Lepista personata, *Fr.* Park woods, Hx. Sept.

16. Lepista cinerascens, *Bull.* Under spruce and pine; Park. Oct.

GEN.—Hygrophorus, *Fr.*

17. Hygrophorus eburenus, *Fr.* Stem swollen; volva persisting; pileus 4½ inch. Under pines in the Park, Hx. Oct.

GENUS—Gomphidius, *Fr.*

18. Gomphidious glutinosus, *Fr.* Common about Hx. Sept. and Oct. Growing on the soil.

GENUS—Russula, *Fr.*

19. Russula vaternosa, *Fr.* Pine grove; Pt. Pleasant. Sept.

20. Russula alutacea, *Fr.* Under pines; Point Pleasant, Hx. Nov.

GENUS—Marasmius, *Fr.*

21. Marasmius oreades, *Fr.* "Fairy-ring champignon." Borders of woods and roadsides. Oct.

GENUS.—Schizophyllum, *Fr.*

22. Schizophyllum commune, *Fr.* On dead wood; common. Aug.

GENUS—Lenzites, *Fr.*

23. Lenzites betulina, *Fr.* Common on birch and stumps; perennial.

ORDER—Polyporei.

GENUS—Boletus, *Fr.*

24. Boletus lividus, *Fr.* Common. Poisonous. Aug. to Oct.

25. Boletus pachypus, *Fr.* In woods; common. Aug.

GENUS—Polyporus, *Fr.*

26. Polyporus fomentarus, *Fr.* On birch; near Truro, N. S. July.

27. Polyporus annosus? *Fr.* On fallen hemlock trunk; near Truro, N. S. July. Persistent, pores? rich umber brown; margins velvety, of a deeper shade; cuticle dense, sooty, spotted or indefinitely marked; slate colored; consists of two masses, both provided with pores, etc., one resting above the other, but forming one substance, attached? its whole length at one side; body of upper mass extends one inch beyond the lower, the free under surface of this mass provided with pores like the lower one; Margins sinuous; pileus about five inches in width, by three inches in thickness; length, about four inches; very solid; woody; the two masses, viewed as a whole, resemble an agaricus with a very thick stipe; width of lower portion, three inches; thickness, three inches; length, about one and one-half inches. I give its characters in detail, because my diagnosis is a doubtful one.

28. Poloporus versicolor, *Fr.* Resupinate; persistent; common. On larch, hemlock, birch, etc.

ORDER—Hydnei.

GENUS—Hydnum, *Linn.*

SECT.—Mesopus.

29. Hydnum repandum, *L.* Near the roots of pines. Point Pleasant Park, Hx. September.

GENUS.—Sistotrema, *Fr.*

30. Sistotrema confluens, *Pers.* In the Park. Oc.

ORDER—Phalloidei.

GENUS—Cynophallus, *Fr.*

31. Cynophallus caninus, *Fr.* Found by Mr. R. Morrow in a drain on his property.

ORDER—Trichogastres.

GENUS—Lycoperdon, *Tourn.*

32. Lycoperdon cœlatum, *Fr.* Common in pastures. Aug., Sept.

33. Lycoperdon gemmatum, *Fr.* In fields and pastures, Common. Aug., Sept.

ART. IX.—NOVA SCOTIAN GEOLOGY.—NOTES ON A NEW GEOLOGICAL PROGRESS MAP OF PICTOU COUNTY. BY THE REV. D. HONEYMAN, D. C. L., F. S. A., *Hon. Member of the Geol. Assoc., London, &c.; Curator of the Provincial Museum, and Professor of Geology in Dalhousie College and University.*

(*Read May* 10, 1880.)

INTRODUCTION.

THE map exhibited is the first of a series which I have been engaged for some time constructing.

They are all on a scale one inch to the mile. Church's county maps are generally used for topography. Occasionally the Admiralty charts are used in the delineation of harbours and portions of coasts of geological importance. From these and railway section books elevation measurements are largely obtained.

The various papers that I have submitted to the Institute and these maps may be regarded as mutually illustrative.

Additional notes, however, seem to be required, in the case of some maps, for the following among other reasons:

1st. Railways have been, or are being, constructed which are of more or less geological importance. These, in their nature, could not be referred to in papers already communicated.

2nd. New facts may have come to light.

3rd. Certain old facts may have to be brought into connection with these new facts for specific purposes.

The following notes on the progress map of Pictou county seem to be required on considerations as above.

GREAT COAL FIELD.

A prominent feature of our map is an irregular polygon colored black. This is the Pictou coal field as defined by Sir W. E. Logan and E. Hartley. I have simply transferred it from the map

accompanying the Report of Progress of the Geological Survey of Canada, 1868-9.

Eastern Extension Railway.

I am indebted to M. Murphy, C. E., Government engineer, for the correct delineation of this line of railway on my map. Passengers cannot fail in observing the great scarcity of rock cuttings along the line from New Glasgow to the eastern boundary of the county. Still it has been the means of reaching many points of interest to the geologist, and it has rendered of easy access a district of great interest, whose geology has been imperfectly comprehended and partly misunderstood.

Leaving the New Glasgow station, we start from the northern side of Sir W. Logan's coal area, traverse the lower carboniferous conglomerate of New Glasgow and succeeding grits. Turning eastward we proceed through drift cuttings and occasional sandstones while crossing Sutherland's River and French River. We continue to traverse the Lower Carboniferous through Piedmont Valley. Entering the basin of Barney's River the geology begins to be somewhat obscure. In fact, we are taking a great geological leap. When we pass from the Barney's River strata to the siding at Dewar's furniture factory, we find that we have descended from the Lower Carboniferous to the Middle Silurian period. The geological gap between represents Devonian and Upper Silurian time. We have just crossed the Western branch of Barney's River. Proceeding a short distance we cross a bridge over the middle branch, descending lower in Middle Silurian time. Still farther on we cross the eastern branch of Barney's River. Here strata are seen partly covered by a *dump*. These are the bottom strata of this Middle Silurian series of the several branches of Barney's River. The Middle Silurian series here, as elsewhere, includes A, B and B' of the "Upper Arisaig series." A is equivalent to the "Mayhill Sandstones" of Wales, according to Salter. B' is of Clinton age, U. S., according to Hall, and B intermediate, according to my own determination, of the typical series in Arisaig Township of Antigonish County. I may state that B' is the "Lower Arisaig series" of "Acadian Geology." Still proceeding on the line of railway, we pass from the base of

the Middle Silurian to a base of strata of Lower Carboniferous age. We thus take a greater leap upwards than was done downwards on our entering upon the Barney's River Basin. The difference is measured by our descent geologically in passing through the Middle Silurian series. Proceeding onward we pass from the Lower Carboniferous into a great Metamorphic series, which enters largely into the constitution of the mountains through which passes the remarkably picturesque "Marshy Hope."

Through this pass flows the eastern branch of Barney's River, and proceeds the line of Railway, in two sub-parallel lines.

A beautiful section of a part of the metamorphic strata is seen on the side of the railway. The latter proceeds onwards through the Valley without any other rock exposures being apparent. About a mile from the County line, strata A. (Middle Silurian) are observed on the side of Barney's River. These extend onward into the County of Antigonish, and are cut by the railway before it reaches the county line. We discontinue our journey until I read notes on the map of Antigonish County.

General Sections.

On the map.

Section line, No. 1.—This section commences on the Pictou and Antigonish Co. line, 2 miles from Northumberland Strait and the same distance from the N. west corner Arisaig Township, the county line being the western boundary of the township. The portion indicated is 3 miles distant from the top of the uppermost member (D) of the typical "Upper Arisaig Series," situate near the mouth of McAra's Brook in the county of Antigonish, and on the Northumberland Strait. This line is *zigzag*, consisting of three straight lines, which I shall designate respectively 1, 2, 3.

Line 1.—Beginning at the starting point proceeds in a direction S. 25 W. to Sutherland's Mountain, *Kenzieville*, a distance of 9 miles. In its course it traverses, 1st. The metamorphic rocks of the Antigonish, and Pictou Mountains. 2d. A carboniferous band of rocks of the same mountains. 3d. A. B. & B. of eastern and middle branches of Barney's mountains, and ends at strata with Diorite, of Sutherland's mountain at the west branch of

Barney's River. I have already incidentally referred to some of the rocks of this section. Having recently made a thorough examination of the Basin of Barney's River, I shall give the results.

Traversing the line of railway, I was led to make Dewar's Furniture Factory siding my halting place. Here I was kindly welcomed and hospitably entertained by the proprietor of the Factory. Examining the dam and race which are situate on the west branch of Barney's River, I was interested to find *silurian strata* where I had expected to find Carboniferous rocks. From cursory observations I had been led to infer that this was a Carboniferous area, and that the Silurian of the east was bounded by the eastern branch of the River. I had supposed Cameron's mountain which was on the right of the road entering the Marshy Hope, which is formed of lower carboniferous conglomerate, to be a continuation of the carboniferous mountains which run on the south of Piedmont Valley. I had also supposed that the Middle Silurian strata (A) which occur on the left side of the same road was a continuation of other strata, occurring in the Marshy Hope at the county line. *See the railway traverse* proceeding.

Accompanied by A. Dewar, I examined the fields to the south of the factory onward to the New Glasgow and Antigonish road in search of the supposed connection of the Carboniferous Mountains without success. We then observed Silurian strata in the middle branch, which led us to follow its course northward to the railway bridge. We found Middle Silurian strata (B) all the way, and, therefore, *no connection* between the Marshy Hope Carboniferous Mountain and the Mountains of the west. We then ascended McPhee's Mountain on the north side of the entrance of the Marshy Hope and found that it also was formed of Lower Carboniferous Conglomerate, like Cameron's, on the south. We afterward examined rocks in the east branch of Barney's River and found that they were the connection between the two mountains, being also conglomerates with the addition of *igneous* rocks. The latter were found to occupy a *central* position, by comparison with the other passage conglomerate outcroppings on the road. The continuation of these mountains on the north was also found to be of Lower Carboniferous age, Cameron's moun-

tain is there connected with the Carboniferous of Merigomish, on the north rather than on the west. It then appears that the metamorphic rocks of the Antigonish and Pictou mountains are *altogether* bounded on the west by Carboniferous rocks of mountains. It at the same time appears that the Middle Silurian (A) strata, on the left side of the road, are completely disconnected with the similar strata (A) toward the county line. These are two note-worthy considerations.

I shall now direct attention to the disconnected Silurian strata. They are brownish quartzose slates, much metamorphosed. They are fossiliferous. The fossils are the usual ones of A of the "Upper Arisaig series." *Petraia, Athyris, Cyclonema.* They are all casts—external and internal. On the east branch of Barney's River, where the railway enters the Marshy Hope, I have refered to similar strata partly covered by a *dump.* These lie to the north of the preceding, and are also cut off from any connection with Eastern Silurian strata by the carboniferous conglomerates and igneous rocks of the same branch of Barney's River. We are thus led to follow a northern course, i. e., down the river. We find them proceeding in this direction, crossing the river at McPhee's, and apparently terminating 3¼ miles from the entrance to the Marshy Hope. I collected fossils in part of these at the road before reaching McPhee's. Two of the specimens lie before me. I shall describe them. The one is a quartzose rock, coloured brown with iron oxide. It has a sharp cast of the exterior of a good sized *Cyclonema.* One side of the specimen has crystals of quartz. The second specimen is of the same character, being from the same mass of rock. It is larger, having a vein of quartz with beautiful quartz crystals. On a corner is exposed a large *Cyclonema,* showing the internal cast entire, also a considerable part of the surrounding external cast. The shell space is entirely vacant. The last specimen is a beautiful and convincing illustration of *rock formation.*

Examining the high ground south of the Marshy hope road, and west of Cameron's mountain of lower carboniferous age, referred to above, we found the southern continuation of our Silurian (A) strata outcropping extensively; after a time it ceases to appear.

We proceeded onward to Mr. McIver's at the back of Cameron's mountain, no outcrops appeared. We then descended McIver's Brook proceeding northward, no strata were seen for a considerable distance, at length strata appeared in great mass, which were found to be our Silurian (A) strata succeeded by B, crossing the brook to proceed westward as mountain strata, including Sutherland's mountain of our section. Their boldness, and hardness of A, have constituted them mountain rocks. Sutherland's mountain strata are tilted ; fossils abound in them, such as Arisaig, and quartz veins are also abundant.

A great proportion of the mountain consists of Diorite. It is well exposed on the back of the mountain reaching nearly to its summit. This is the usual association in Nova Scotia, east and west. In Antigonish, Pictou, Annapolis and Digby counties, strata A of the upper Arisaig series are invariably associated with intrusive Diorite. Succeeding this band are B. & B'. strata, these contrast strikingly with the preceding. They are generally very soft furnishing the *pencil stone* of *How's Mineralogy of Nova Scotia*, when exposed they become clay. The lower strata contains my " Lingula nodule bed." As usual at my last visit I extricated a great number of nodules from its two exposures These contain beautiful *lingulæ* of several species. B strata as usual furnish a great variety of genera and species peculiar to our Clinton period. They will be found included in our *lists of fossils* in the sequel. The west branch of Barney's River is the approximate boundary of this Middle Silurian area. The Carboniferous begins in the river at the mill north of McPhee's Silurian (A) strata. At Dewar's Furniture Factory strata B extended beyond the river. Between Robertson's and the Rev. Mr. McKeehan's, the carboniferous mountains south of Piedmont Valley, have their extremity on the east. This apparent intrusion into the Middle Silurian originally led me to infer a connection with Cameron's mountain already referred to.

ANTIGONISH AND PICTOU MOUNTAINS.

From McPhee's extremity of A (Middle Silurian strata) I crossed the Middle Silurian and then the Carboniferous, and reached the old mountain road at Bailey's Brook. At the bridge and

fulling mill ruins, Igneous rocks were observed, of lower carboniferous age.

A short distance above the bridge I examined a mass of limestone of lower carboniferous aspect. J. McLellan who pointed it out to me, assured me that similar limestone had been quarried in the high ground to the east of the mountain road and used for building purposes. Farther on the road side and mountain sides and summit, outcrops of metamorphic rocks appear, they are quartzites and argillites. No member of the Upper Arisaig series has thus far been seen on the side of this metamorphic series. The carboniferous bands along it from the Antigonish county line to the Marshy Hope road. We shall now examine the south on Marshy Hope side. On the road below W. Robertson's and at the watering place for horses, the felsites of the mountains appear after the carboniferous outcrops, on the left side of the line of railway opposite. At Pushie's is an interesting section of a steep side of the mountain, the rocks of this section are felsites and argillite, the felsites containing *micaceous hematite with pyrite.* Beyond this there do not appear any rock exposures until we come opposite the Marshy Hope station. Here at a bridge over Barney's River, of the road entering the Sutherland settlement, Middle Silurian strata (A) outcrop. Entering the settlement we find argillites with quartzites on the side of a tributary of Barney's River. On the summit of the mountain at Sutherland's Argillite outcrops. These resemble the James River Fall rocks. The latter are in Antigonish county—9 miles east, from the Sutherland mountain outcrop. The Middle Silurian (A) strata of the bridge extend into Antigonish county as far as Lindsay's stables. At McLean's they are cut by the line of railway, after this the railway passes them on the south. I discovered these many years ago with them. *Lingulæ, Petraia and Cornulites* were also found in them from time to time. I was accompanied by the Rev. Mr. Goodfellow and son, when I made my recent examination. We found *Petraia forresteri* (Salter) in the *strata* at Lindsay's stables. At McLean's we found abundance of *Cyclonema, Orthis and Lingula* associated with the characteristic *Athyris* (casts) and *Crinoidea.* From the moun-

tain side above, Mr. Goodfellow brought a piece of rock which was found to be a conglomerate of peculiar character. It is almost identical with the dioritic conglomerate which I found at Wentworth, I. C. R., with other conglomerates and rocks, which led me to proper views of the age of rocks of the Arisaig mountains, and to distinguish them from the "Lower Arisaig series," (Archæan Dana) and "Upper Arisaig series," (Middle and Upper Silurian,) by making a " Middle Arisaig series " and correlating it with Professor Ramsay's "Cader Idris" (Lower Silurian). The distance from the north side of Bayley's Brook to the south side McLean's is 5 miles.

Other Mountains.

My attention was also directed to the mountains on the south side of the Marshy Hope railway. Opposite the Middle Silurian (A) strata last examined, is a Brook (Bryan Daley's) which penetrates these mountains. Ascending this brook the first rocks that I met with were apparently carboniferous strata consisting of clayey shales and conglomerates. Succeeding these are exposures of metamorphic slates — argillites. I shall have to investigate these before I can arrive at any satisfactory conclusion regarding their age. In the meantime I regard them as a continuation of whatever rocks may form the mountains at McIver's, and, therefore, as underlying the strata A, B of the Barney's River Middle Silurian area. The same doubtless extend farther west behind Sutherland's Middle Silurian Mountain of our section, so that they may be regarded as *Pre-Middle Silurian* and, therefore, *Lower Silurian.*

Section line 1, division 2 extends from Sutherland's Mountain to French River—a distance of 6 miles. Its course is N. 80 W. It begins in the diorite of Sutherland's mountain, crosses A strata of the mountains, passes through B strata with its *Lingula nodule bed,* traverses B' south of Cooper's and at Turner's with its Graptolithus clintonensis (priodon), Dalmanites, Leptocœlia, Strophomena, etc., and ends at an igneous rock in French River (a Lower Carboniferous rock).

This Middle Silurian area is intersected diagonally by the line of section. It is bounded on the north by the Carboniferous

mountains—these have been already referred to as on the south of Piedmont valley and the line of railway. The mountains on the south are an extension of the strata of Sutherland's mountain. Strata B and B' lie between.

Division 3 extends from French River to the west side of Irish Mountain, a distance of twenty-seven and a half miles. Its course is S. 55 W. It traverses first an area of Lower Carboniferous rocks, then the Middle and Upper Silurian of Sutherland's River, McLellan's Mountain and Brook, and Irish Mountain, terminating in the Lower Carboniferous of East River.

The Silurian formation retreats after it reaches the west branch of French River, and forms the compound curve which connects the Silurian area of the Barney's and French basins with those of East River basin. The connection is very complicated, consisting of Anticlinals, Synclinals and Monoclinals; yet there is no great difficulty experienced in resolving the complications in consequence of the constant recurrence of well known characteristic fossils and obvious structure. Vide Papers in Transactions 1870-1-2.

Section 2nd.

This section begins where the preceding section ends. Division No. 1 proceeds S. 19 E., a distance of 4.3 miles to Fraser's (sadler). Beginning in the Gypsum it passes through the Lower Carboniferous to the Limestone of McLean's Lime Kiln at Springville, a little farther it enters D strata, with abundance of characteristic fossils. At the late Rev. Angus McGillivray's pasture, it enters C strata with fossils characteristic of this horizon. It then passes through an obscure region, in which we may presume that B′ (Middle Silurian) strata are to be found according to the analogy of the preceding section (No. 1). We then come to a hill having fossils, which show that C strata have been left behind. Reaching Fraser's (sadler) we come to the *first discovered outcrop* of the iron ore of this division, or series, which we would, for future reference, name *Iron Ore, No. 1.* Division No. 2 of the section running N. 59 E., 0.6 of a mile, passes through the lowest strata of this series, which we shall, in the meantime, designate A strata. It then traverses a wide dyke of igneous

Diorite. Division No. 3 runs N. 82 E., a distance of 2.2 miles to John McDonald's Hill, Blanchard, passing through Middle Silurian strata A. At McDonald's hill it cuts an intersecting outcrop of D strata (Upper Silurian) with characteristic fossils. Division No. 4 passes N. 59 E., a distance of 0.6 of a mile, at its termination it cuts the Blanchard Iron Ore. This is a bed of fossiliferous red hematite 30 feet thick. The ore and the containing strata have fossils characteristic of A (Middle Silurian). I will call this *Iron Ore. No. 2.* Division No. 5 runs S. 45 E., a distance of 3 miles. The half of this distance, 2.5 miles, it passes through Middle Silurian strata and then it reaches crystalline metamorphic rocks of Archæan age (Lower Arisaig). It traverses these a distance of 2.5 miles to McPhee's, still on the north side of East River division. It continues in the same direction S. 45 E., a distance of 0.6 of a mile, crossing the river and passing into a band of black metamorphic Middle Silurian strata. These have an east and west strike. At a farther distance of 6.8 miles, west, we reach the first outcrop of Iron ore at McDonald's, due south of Blanchard. I shall name this *Iron Ore No. 3.*

Remarks on the Divisions of Section Line No. 2.

Division 1.

The series of Silurian rocks of this division might be regarded as a typical series, if Arisaig did not put in a prior and superior claim. I shall consider the series of Springville in the order of its development. D. strata at McLean's have received the most attention on account of the abundance of fossils. The fossils and their order of occurrence correspond in a striking manner with the typical D at Moydart, Arisaig Township.

The fossils are, with a few exceptions, of the same orders, genera and species; the mode of their occurrence and association remarkably corresponds. A ledge on the height at the back of McLean's and to the north of David's lake, has precisely the same fauna as a corresponding ledge at Moydart. The fauna are *Cornulites flexuosus*, *Homalonotus dawsoni*, *Spirifer subsulcatus* and *Avicula honeymani*, associated and in abundance. The only difference is in the degree of metamorphism and in the state of preservation. All the strata of the series of Springville are more highly

metamorphic than in the type, and the fossils, generally, are less perfectly preserved. C strata here correspond and differ in like manner when compared with the typical strata at Knoydart, Arisaig Township. The *Cephalopoda* are as large as in the type. An orthoceras at Springvllle is the largest found in Nova Scotia. Similar species appear in groups, as in the type. They occur in the same relative position. Remarkable forms are also found in the two localities. Here the strata are more highly metamorphic. This action has also affected the state of preservation of the fossils. They are generally casts. Strata D may be regarded as extending from the north end of Irish Mountain to Holmes' Brook. Before reaching McLean's, however, they seem to break and their course to change. At Macintosh's brooklet they make a sort of a water-fall, near their junction with the Carboniferous Sandstones that underlie McLean's Limestone. From this brook to Holmes' brook we have the D strata of division (1). Their width is considerable. Their outcrop, with fossils, was followed to some distance behind David's Lake. At the back of Irish Mountain C strata possibly exist among the strata of the abrupt descent to Cross Brook. They were not detected from want of fossils. At Holmes' brook their upper part becomes distinct in closest contact with Lower Carboniferous Limestone. Their immediate contact forms a breccia. Here the water sinks, leaving the remainder of the brook dry in summer. The water that has disappeared after a subterranean flow, reappears at Holmes' sluice and flows *sub diu* to the river. Limestone and C strata are seen in approximate contact at the opening; in the strata east of the sluice the large orthoceras was found and other characteristic fossils. In an outcrop not far from the road crossing, on the same side of the sluice, other characteristic fossils were found. The *same strata* are found in contact with the limestone on the river side at McPhee's. These strata passing along N. E. on the N. side of the river form mountains of steep ascent and considerable elevation. In some places the strata are bare, especially toward the mountain summit, resembling a house top of *high pitch*. The lower strata of McGillivray's pasture continue their *rampart* course with a depression on the left onwards to the end of the

mountain, having the same characteristic fossils at the end as at the beginning; limestone is seen here in the river as at McPhee's, although not in contact with the strata.

A RED LETTER DAY IN THE HISTORY OF PICTOU AND GEOLOGY OF DIVISION C.

On the top of a hill at the end of the C strata mountains, on the line of the depression of the mountain summit already observed, on the right of the McGillivray strata I found an exposure of strata lithologically distinct from D. & C. These so much resemble the B' strata of Doctor Brook, Arisaig Township, that I was led to search in them for fossils. This happened on a day ever to be remembered in Pictou, when H. R. H. the Prince of Wales was in Pictou *en route* to Prince Edward Island. Few were in the country that day who could find the ways and means of getting to the town, these not being available I continued my search for fossils and found them. I collected 4 specimens belonging to a new species of Homalonotus which is known in my collection as *Homalonotus Siluriae Principis*—Prince of Wales Homalonotus, two large *lingulæ* were discovered, also a *discina* and a form *Incertae sedis*.

DESCRIPTION.

C and D strata as at Arisaig have each their characteristic homalonotus. The number of specimens of a species of homalonotus found in our new strata of the mountain seems to form a characteristic. *Homalonotus dawsoni* is characteristic of D. *Homalonotus salteri, M. S. is characteristic of C.*

This was considered by Salter from the appearance of the pygidium to be Homalonotus *delphinocephalus*. When examined by him the head of the form was unknown. Specimens of the head were afterwards found which showed that it is not *delphinocephalus*. I have regarded it as a *new species* and named it after the late distinguished Palæontologist of H. M. Geological Survey of Great Britain.

The thorax and pygidium are all that is known of the *Homalonotus Siluriae Principis*. The thorax has the character of the genus, being *level backed*; the pygidium is different from that of *Homalonotus salteri* in not having a terminal spine. From

this and *Homalonotus dawsoni* it differs in being distinctly *trilobate*; the others have their furrows deep and continuous from side to side; this has the side *furrows* coming opposite to the *ridges* of the axis. It is much stouter than the others. The specimens are more or less distorted by metamorphism, the containing strata being highly metamorphic.

The first appearance of homalonotus in the typical Arisaig series is in B', where it is associated with casts of *pentamerus oblongus.*

This leads me to refer the strata in question to B'. The association of the large *lingulæ* seems to indicate the same horizon, as they are found in the same position at Arisaig. These are the only lingulæ found as far as I know at East River. Discina is larger than discina of D Springville; it more resembles the discina of B', French River. The form referred to *incertæ sedis* resembles the valves of a *pholas* open. It is finely striated across.

These considerations led me to consider the mountain strata as the upper part of B' of the series.

On the McLellan's mountain road, at the back of McGillivray's is a deserted farm, succeeding an obscure forest area. Here I observed strata which resemble fossiliferous A strata highly metamorphic. I did not succeed in finding fossils in them. I found a *petraia forresteri* in the bed of Holmes' Brook which might have come from a part of these strata, as this brook passes not far from the said *old farm.* The strata of this farm extended in the line of strike, cross the section line, near the position of *Iron Ore No. 1.*

This Iron ore is now an old acquaintance. It is 25 years, less six weeks, since I was first introduced to it by the late Rev. A. McGillivray. Then it was scattered all around his mountain farm. Every cairn of stones had its large masses and small pieces of beautifully crystallized brown Hematite. This led Mr. McGillivray naturally enough to suppose that the vein of ore was situate within the bounds of his farm, and that its discovery would add to the value of his property, especially as the General Mining Association was supposed to have no reservation except for *Gold, Silver, and Lapis Lazuli.* Every year, about the same

season, we had a search for the hidden treasure. In 1869, after a freshet, I considered that I had found unmistakable evidences of its position, near the upper outcrop of strata C. In apparently the same position, I came upon the trenches of the General Mining Association, at the end of the C. Strata Mountains, with a great accumulation of masses of ore on the sides of the road, near the bridge that crosses East River.

This led to the conclusion that the vein traversed *Aymestry Limestone* strata. In 1864, when making a preliminary Geological survey for the N. S. Government, *vide Blue Book,* Fraser's ore was pointed out to me in a small brook. There was not the least difficulty in recognising this as approximately *in situ.* Mr. E. Hartley, of the Geological Survey of Canada, sank a pit here and found the ore *in situ.* Considering the strata of Fraser's site as Middle Silurian I was only perplexed by the indications, and led to the conclusion that we must wait until the vein was traced from Fraser's onwards.

I am just waiting for an opportunity of examining the course of Mr. Gilpin's excavations, to satisfy myself in reference to the course of the vein, so as to indicate its geological relations on the map.

The carboniferous approaches the river on the south side opposite Fraser's, as is indicated by limestone or gypsum pits. It likely overlaps, or otherwise joins the ferriferous Middle Silurian as it does the C strata farther down the river.

Division (4.)

Iron Ore No. 2.

This ore corresponds very closely in character and age, with the *red ore* of Nictaux, both are fossiliferous and siliceous. In the ore under examination, *Athyris* is found, which is elsewhere only found in A strata. Its geological horizon has therefore been indicated on the map as Middle Silurian. Mr. Gilpin's explorations seem to confirm this view, as he found its extension at Ross'. Its course is therefore approximately in the strata, outcropping in Squire Campbell's marsh, in which I found a pygidium of Dalmanites of B′ Arasaig and other fossils (Crinoidea). The extension of these at Ross's also produced fossils. They were

sent in my collection of fossils to the Museum of the Survey, Canada.

Division (4.)

Archæan.

I found and examined these rocks outcropping in all directions along the road which leads to Blue Mountain. I have examined them to a distance of two miles. These are separated from the river by a band of Middle and Upper Silurian? strata, which borders on the north side of the river, and comes into contact with a considerable bed of Lower Carboniferous Limestone.

The archæan rocks are felsites. In some places they have appearance of copper and micaceous iron ore. An outcrop of these appears at McPhee's giving the series a width of 2.5 miles. This may be the west side of the *archæan* of the Keppoch and Ohio, Antigonish County. I have not had an opportunity of tracing a connection between the two areas of crystalline rocks.

Division 5.

Iron Ore, (No. 3.)

The rocks of this division contain the specular Iron ore at McDonald's on the south side of the river and S. of Blanchard's. This ore *in situ* was first shown to me by Mr. Donald Fraser in 1861, when I collected specimens of the various ores of the district for the London Exhibition of 1862. It seemed to indicate a deposit of economic importance, subsequently in 1869 when I investigated its geology the outcrop was obscured by an enormous pile of stones on its top, and it was with difficulty that I secured a passable specimen of the ore for our Museum collection. I examined the containing strata and found them to be dark coloured metamorphic strata. On emerging from the woods on my return to the river, crystalline rocks were observed in a field on the right. The outcrop of these is of considerable extent. The rocks are igneous and intrusive, like other rocks of the section on the north side of the river. We had thus the *appearance* of a monoclinal, the dip being southerly and the strike east and west. The extreme metamorphism of the rocks and the general aspect gave no encouragement for the search for palæontological evidence of age in the rocks themselves. I therefore searched for other

exposures on the line of strike. I found the rocks exposed in the course of an adjoining brook. I followed these towards Springville until I came to lower carboniferous rocks, which separate the strata under examination from the strata of Iron Ore (No. 1) on the north side of the river. Afterwards I examined the strata of the division 5 of the section which I found in the river without any carboniferous intervention between north and south, and in proximity to McPhee's *archæan outcrops* In this way the areas of pre-carboniferous rocks having Iron ore on the *one* side of the river, were connected directly with the fossiliferous and pre-carboniferous rocks on the south side. This seemed to be one important element in correlation. Proceeding westward, down the river on its south side, I found one brook with a mill-dam; here is another exposure of the strata under examination. Still farther at Pleasant Valley another brook occurs having a mill-dam, and an exposure of the same strata. In addition I observed strata of lighter colour and greater compactness, I readily recognized a lithological feature of frequent occurrence at mill seats on Sutherland's river and its branches, where palæontology is available for the solution of difficulties. There I had to refer the corresponding strata to A and B B', middle silurian. If lithological evidence is worth anything in correlation, it surely is of some weight in the same district even at the distance of 9 or 10 miles.

The next exposure is in the brook east of the *situs* of *Iron ore, (No. 3,)* McDonald's brook. Here we have the best exposure of the strata. Along this brook I examined the strata to a considerable distance southward in search of a continuation of the Iron ore without success. Returning I reached an old mill-dam having strata of the same lithological character as the preceding, indications of A, B and B', middle silurian. Proceeding still along the bed of the brook, I found, after a considerable interval of obscurity, compact strata, having a southerly dip. These strata are hard and jointed *with films of micaceous oxide of iron in the joints.* Succeeding these at the bridge which crosses the road running up the south side of the river, I found black slates having obscure fossils, but which I have little doubt are of

Clinton age, farther on where the brook enters the river is a green marble of lower carboniferous age, and on the north side of the river opposite, in close connection with an igneous dyke is the continuation of the Blanchard strata, middle silurian, having lower carboniferous limestone in contact, I have no doubt whatever that there is a connection of the strata of the north and south areas of fossiliferous rocks under the bed of the river. The extension of the igneous rocks observed on the road to the Iron ore, No. 3, would occupy the obscure interval in the brook between the two sets of strata forming a *complete anticlinal* instead of the apparent monoclinal.

All this seems sufficient to determine the approximate age of the strata containing Iron ore, No. 3. This is consequently indicated on the map as middle silurian, which may be called the "upper series of the Cobequids." Geologists have had to call in the aid of the iron divisions of section No. 2 of our map, and to regard the former as devonian, upper or middle silurian, according to the views entertained regarding the age of the latter.

PALÆONTOLOGY OF THE REGION MAPPED.

The sign ff is of frequent, occurrence on the map, in A, B, B', C, D of the "Upper Arisaig series" having fossils, that belong

1st to the Middle Silurian period.

2nd to the Upper Silurian period.

3rd We have ff occurring in limestones of the Lower Carboniferous period.

4th In the south and north side of the coal measure polygon.

I shall briefly collate and examine the Middle and Upper Silurian Faunas; and then examine the fauna of the Carboniferous period.

Regarding the Silurian series of the Springville division of section ten as representative of the Typical series. I shall group the scattered fauna around its members. Our passage will thus be direct into the lower and into the middle carboniferous age.

FOSSILS OF A. FROM THE PICTOU AND ANTIGONISH COUNTY LINE AND DIVISIONS OF SECTION 1.

Nos. 1, 2, 3 and Sutherland's river.

Coelenterata.

Petraia forresteri.
Petraia, sp.

Annuloida.

Crinoidea.

Annulosa.

Cornulites.
Cornulites, trumpet shaped., Salter M. S.

Trilobita.

Calymene, sp.

Molluscoida.

Brachiopoda.

Strophomena corrugata.
Orthis, *species.*
Athyris, species.
Spirifer, like striatus
Spirifer, sp.
Rhynchonella, sp.
Lingulæ.
Mollusca.
Gasteropoda.
Cyclonema.

FOSSILS B.

Section No. 1. Division No. 1 & 3.

Lingulæ of several species chiefly in nodules.

FOSSILS B'.

Section No. 2. Div. No. A, Springville and e Blanchard

Sect. No. 1. Division No. 3, 6.
Coelenterata.
Graptolithus.
Graptolithus clintonensis, (priodon).
Crinoidea.
Cornulites.
Tentaculites.

Crustacea.
Beyrichia.
Trilobites.
Homalonotus Siluriæ Principis.
Dalmanites. several species.
Molluscoida.
Brachiopoda.
Strophomena depressa, abundant.
Leptæna, sp.
Orthis elegantula, abundant.
Leptocœlia intermedia, abundant.
Spirifer, sp.
Lingulæ, species large.
Lingulæ, sp. small.
Discina, sp. large.
do. sp. intermediate.
do. sp. small.
Mollusca.
Cephalopoda.
Orthoceras, small.
Conularia.
Incertae sedis.

FAUNA OF C. SPRINGVILLE.

Mollusca.

Cephalopoda.

Orthoceras *large*
Orthoceras, sp.
Orthoceras, sp.

Molluscoida.

Brachiopoda.

Strophomena, sp.
Strophomena, sp.
Strophomena, sp.
Strophomena, sp.
Rhynchonella saffordi, abundant.
Rhynchonella wilsoni.
Rhynchonella, sp. abundant.

Rhynchonella, sp.
Meristella didyma, abundant.
Atypa reticularis, coarse.
Spirifer crispus ?
Crania, sp.
Crustacea.
Trilobita.
Calymene blumenbachi.
Homalonotus salteri.
Sutherland's river in boulders,
Homalonotus Salteri.
Crinoidea.
Cornulites, large species.

Coelenterata.

Favosites fibrosa.
Stenopora.

Mollusca.

Cephalopoda.
Ascoceras.
Ormoceras, sp.
Orthoceras, sp.
Heteropoda.
Bellerophon, trilobatus.
Gasteropoda.
Holopoea.
Pleurotomaria.
Acroculia haliotis.
Lamellibranchiata.
Clidophori.
Avicula honeymani.
Modiolopsis.
Brachiopoda.
Spirifer subsulatus.
Chonetus, nova scotica.
Crania acadiensis.
Rhynchonella, various.
Discina, sp ?

Crustacea.
Calymene blumenbachii.
Homalonotus dawsoni.
Dalmania logani.
Phacops stokesii ?
Proetus stokesii ?
Entomostraca.
Beyrichia.
Crinoidea.
Cornulites flexuous.
Tentaculites.

The greater part of the organisms of D Springville are identical with those of D Arisaig. Still only a very small proportion of the species in the type have yet been found here. The same may be said of C, the other Upper Silurian member of the "Upper Arisaig series." When I make notes on my new map of Antigonish County this will be made manifest. It is evident however, even from the Springville series, that the fauna of Nova Scotia silurian had in C and D attained their maximum development especially in cephalopoda, pteropoda, heteropoda, gasteropoda, lamellibranchiata, brachiopoda of certain genera trilobites and crinoids. The exceptions are as follows, viz: *Brachiopoda, orthis*, athyris, spirifer, these have their beginning and climax in A, lingulæ in A and B', are rare in B' and very rare in C and D. The trilobite, *dalmanites*, is characteristic of B', *Calymene* is in A, C and D. The graptolithus expires in B'. The pteropod conularia is peculiar to B'. Petraia have their beginning, climax and end in A.

Marine vertebrates do not appear; all are invertebrates. The cephalopoda are of the highest order, and at the same time carnivora of the period.

CARBONIFEROUS (f f.)

The fauna of the Lower carboniferous limestones succeed the Upper Silurian, in the County of Pictou and elsewhere in Nova Scotia as far as is known. This makes a large break in the succession of life. To fill up the gap the Devonian or Old Red Sandstone is required, with its fishes, crustacea, mollusca, &c.

The Carboniferous formation may be seen from the map to come into contact again and again with every member of the Upper Arisaig series, and even with the intrusive rocks that give strike and dip. It is found overlying these strata and intrusive rocks, and overlapping them *a latere* and *a tergo*. The Carboniferous strata in these positions are respectively conglomerates, sandstones, claystones and limestones. These have been formed simultaneously by mechanical and organic agencies, in various conditions of formation. We then have alternations of conditions, and sandstones and claystones are made to succeed limestones, and limestone to succeed sandstone and clays.

The oldest limestone at Springville is that which is in contact with the strata of C. in Holmes' Brook and River. This is as far as seen non-fossiliferous; the next is that of McLean's quarry and Lime brook. Sandstone strata intervene between this and D strata; this is fossiliferous. the fossils are corals of the genus *Lithostrotion*. At Grant's factory on the river are limestones with clayey strata; these are next in order; they have a richer fauna. Others on the river farther down and on the West Branch are also fossiliferous. In the last the *pteropod, conularia* is found. This *genus* has already been recognized in B' Clinton of French river.

The collated fauna of the Springville limestones, are:

Localities.	*Cœlenterata.*
	Actinozoa.
Lime brook.	Lithostrotion pictoense.
Factory, E. river.	*Crinoidea.*
	Molluscoida.
	Producta cora.
	do. martini.
Black Teeth.	Spirifer, sp.
	Lamellibranchiata.
Factory.	Nucula ?
	Gasteropoda.
	Genus ?
	Heteropoda.
	Bellerophon decussatus.

Pteropoda.
Conularia.
W. B., E. River. *Cephalopoda.*
Orthoceras.
Pisces.
Cochliodus sp. Salter.

In my London Exhibition collection, Mr. Salter recognized two teeth of Cochliodas. I was puzzled to know what they were. He at the same time detected specimens of *Bellerophon decussatus.* I believe this is the first recognition of Fishes of so early date in Nova Scotia, and the first identification of *Bellerophon* in the Lower Carboniferous Limestone.

The Silurian Fauna have totally disappeared. As far as Nova Scotia is concerned, this is no great marvel, when we consider the character of the agencies that were at work during the lapse of the Devonian Period, and their stupendous operations. Thus and then Nova Scotia became largely subærial, had its form well defined, and its mountain systems established. Its coasts presented to the seas of the Lower Carboniferous period rock arrangements to a large extent corresponding with those now existing. Hence we have the carboniferous rocks directly on Archæan, Cambrian and Silurian systems, just as the marine accumulations of shingle, sand, clay, dead shells, and their debris now rest, or are in process of formation. We should take this into account, as explanatory of rock arrangements which are readily by some referred to fault occurrence. Faults there are of course, and enough of them, without an unnecessary multiplying of their number.

The conditions of the Carboniferous Period were greatly different from those of the Periods preceding, the character of life differed in accordance. The preceding were invertebrate, now it is vertebrate, Cephalopoda are rare, reptiles appear, fishes became associated with such as do occur, to regulate the number of the mollusca that now begin to exist, increase and multiply.

The Cochliodus of Springville is akin to the Port Jackson Shark, which is also a cochliodont. The Cochliodus is palatal, forming a mouth pavement adapted to the grinding of molluscoida

or molluscan shells. The Cochliodus of East River does not seem to have been a large species ; the teeth are not over a half of an inch in size. Our Cochliodus seems to have been an approximate cotemporary of the *Gyracanthus magnificus* of Cape Breton. A formidable and predaceous race of fishes, that pervaded the Nova Scotia seas of the Lower Carboniferous Period. Whence they came we are unable to discover. The Ichthyodorulite of Cape Breton in the Provincial Museum is regarded as unique; its length is about 22 inches, it is stout in proportion.

MIDDLE CARBONIFEROUS.

The last fauna is found in the coal formation polygon.

The localites are :

1. Turnbull's mine, McLellan's Brook.
2. Deacon McKenzie mine, New Glasgow.
3. Crown Pottery mine, New Glasgow.

At 1 and 2 I found, a number of years ago, a number of teeth of Diplodus. They are so-called from their form which is double, one lanceolate is upright the other is recurved, both are crenulated. The root has a heart-shaped prominence on its front. They belong to fishes of the shark family (Hybodont).

The localities where I found them are situate on the south and north sides of the area ; from No. 3 mine I received about the same time from a miner the cast of a tooth of large size, with its owner a Holoptychius.

The teeth of Diplodus are of various sizes, showing a graduation as in the mouth of the shark. Associated with these, at MacKay mine were large and small ganoid scales and beautifully striated spines. The late Professor John Phillip of Oxford, seeing these specimens in my London Exhibition collection of 1862, remarked upon the coincidence between the Nova Scotian and British *faunas* in both having *diplodus.* He also observed that the N. S. teeth were much larger than the British. I would refer to another coincidence ; the late Professor How of Windsor, N. S. had just discovered a trilobite in the Lower Carboniferous limestones of Kennetcook, N. S. and forwarded me a specimen for identification. I showed it to Professor Phillips as his *namesake* (Phillipsia Howi ; Billings). He also remarked upon the

coincidence of the N. S. Carboniferous faunas with that of the mountain limestone of G. B.

We have thus examined the *marine fauna* of the formations of Pictou County, and found an interesting and beautiful succession of life, with only one serious break, from, the Mayhill Sandstone, Intermediate Silurian—of Salter, to the Middle Carboniferous—Coal measures, i. e.

Beginning with Upper Arisaig A. Mayhill Sandstone, or the possible equivalent of the Medina Sandstone, U. S., we have proceeded upwards through B Arisaig, where equivalence (British or American) is doubtful; then B' Arisaig (which is considered by Hall as of Clinton Age, U. S.) next we have passed through the C. Arisaig Aymestry Limestone, (according to Salter) Upper Silurian; then the Upper Ludlow (Salter) or the Lower Helderberg and "Upper Arisaig" of Acadian Geology. We have bridged the Devonian Gap succeeding, and passed through the Lower Carboniferous into the Middle.

APPENDIX.

Nova Scotian Archæology.

Ancient Pottery.

At a meeting of the Institute December 8th, 1879, attention was directed to specimens of supposed ancient pottery, belonging to the Provincial Museum.

Dr. J. B. Gilpin at my request brought the subject before the Institute.

He agreed with me in regarding the specimens referred to as of pottery of a rude and *very ancient character*.

The first specimen of our collection, when brought to the Museum was in fragments. When restored its singular character and construction rendered it interesting and perplexing. The bottom is a piece of quartzite, flat and subcircular. This is the basis on which the rest is formed. The other material is a sort of clay. The whole is symmetrical and saucer-shaped. The interior is banded concentric. The outside is plain but not smooth. There are now 27 specimens in the Museum, all with one exception——a small one——have stone bottoms. The stones are quartzites and argillites. Their several shapes generally conform to the stones selected for the bases. Their structure is uniform. They are altogether different from specimens of ancient pottery which have been found by Judge Desbrisay in Lunenburg County, and the Rev. Dr. Patterson in Pictou County, associated with stone implements, and have every appearance of greater antiquity.

Mr. J. T. Bulmer, the Librarian of the Legislative and Historical Library, on a recent visit to the Public Museums of the United States, after a search for corresponding pottery, found 3 specimens in the Museum of the Smithsonian Institution at Washington. These are believed to be productions of the Esquimaux.

Our *large find* in Nova Scotia, of which our 27 specimens is only considered to be a representation, thus tends strongly to

confirm the opinion of archæologists, such as Mr. Robert Morrow, who has long maintained that the Esquimaux inhabited Nova Scotia in the 10th or 11th century.

D. HONEYMAN,
Curator of the Provincial Museum.

Halifax, Oct. 14, 1880.

BRIDGEWATER, Decr. 6, 1879.

DEAR SIR,

I received by to-night's mail your card asking for a few notes on the finding of pottery, of which I sent you specimens.

In July 1877, I heard that Indians had found pieces of pottery by the "La Have," not far from this Village, where people of their race had an encampment in early times. I went to the place with one Venall, who told me that having found an arrow head near the surface, he, and other Indians had removed the ground and discovered pottery. We searched and found arrow heads and pottery, nearly all at a depth of two feet and more. One of the pieces I retained, has a round foot, as if originally part of the bottom of a pan or vessel. Another has a round hole, through which a string may have passed for carrying or hanging up the vessel. The pieces are of varying thickness, and differ in the making or designs. In some the latter appear as if made with a finger nail, in others with a stick. The marks on the upper edge, or what was the top of the vessel, are in some as if made with a round-edged stick, while others have marks like tally notches and close together.

M. D. DESBRISAY.

Rev. Dr. Honeyman.

APPENDIX TO NOTES ON THE BONES OF S. SALAR.

Plate 1.—Skeleton of Salmon from Labrador, showing left side. Length of Fish 35½ inches from end of snout, when the jaws were closed, to the centre of the caudal fin. The shoulder girdle and pectoral fin, together with the ventral fin, saddle bone, and

part of the 9th, 10th and 11th dorsal short caudal fin-rays removed.

Plate 2.—Skeleton of young S. Salar, left side, hatched at the Breeding Establishment, Bedford, near Halifax. Length of fish from end of snout to the centre of the caudal fin $21\frac{9}{16}$ inches. Right shoulder-girdle and pectoral fin remaining, ventral fins removed. A marked fish, part of the three first dorsal fin-rays having been cut off. Muscular fibres of the anterior attachment of the anal fin to the general structure remaining.

Plate 3, page 162.—Interspinous bones. The third interspinous bone was broken off in handling, and, unfortunately, lost.

Plate 4, pages 162, 163, 172 to 174.—Dorsal fin and interspinous fin-bones.

Plate 5, pages 166 to 168, 176 to 178.—Anal fin and interspinous fin-bones.

Plate 6, pages 163, 164, 169 to 171, 174 to 176.—Showing caudal fin, saddle bone, hypural bones, bone with cup-shaped dorsal extremity. The saddle bone is removed to show the three (I find this to be the number in another fish from Labrador) representative rays, and is shown in this plate above the place it occupies in the fish.

Plate 7, pages 179 to 183.—Left side, upper, or dorsal aspect.

Fig. 1.—Pelvic bone, with part of right pelvic bone.

Fig. 2.—Ventral Fin.

Fig. 5.—Ventral appendage, with ligaments to left.

Fig. 4.—Ventral fins from young Salmon,—lower or ventral aspect.

Fig. 3.—Ventral fins Codfish—upper or dorsal aspect.

Plate 8, pages 183 to 187.—Left shoulder girdle, outer side.

Fig. 1.—Supra-clavicle.

Fig. 2.—Inter-clavicle.

Fig 3.—Clavicle.

Fig. 4.—Pectoral fin.

Fig 5.—Urohyal bone. In the plate this bone is rather close to the clavicle, owing to the shrinking of the integument.

Plate 9, pages 183 to 187.—Left shoulder girdle, inner side, numbered as plate 8.

Plate 10, pages, 183, 184.

Fig. 1.—Bones from Codfish, (outer side) corresponding to figures 1 and 2, plates 8 and 9.

Fig. 2.—Remainder of shoulder girdle, Codfish—outer side—lower part of accessory bone, page 185, showing to the left of "2."

Fig. 3.—Codfish—Pectoral fin.

Fig. 4.—From a Salmon, left side—same fish as plate 11.

a. Shows where spinal chord (myelon) divides.

b. The notochord where it passes out between the Y shaped bones.

c. Branch of spinal chord (myelon) lying upon the notochord.

d. End of the notochord.

e. Bone,—one of a pair between which the notochord passes, and by which it is protected—the anterior end supported on a pin, the posterior end is attached by fascia to the notochord. This pair of bones are of curved, irregular shape.

Below *e* is the short, irregularly shaped bone (also one of a pair) mentioned on page 164, the posterior end (right hand in plate) is attached by fascia to the anterior end of *e*; when these bones are in their proper position, they protect each side of the notochord, nearly to its extremity.

f. The nervous corpuscle.

In the centre of fig. 4, the pulsating? sack is shown; the outer surface being turned upwards, and marked by a wire loop.

Plate 11.—Shows the right side of the caudal fin of a Salmon. The dorsal spinous rays are removed to show the spinal chord (myelon). One hypural bone, and part of the central caudal rays removed to expose the nervous corpuscle and part of cartilaginous rim (page 169). One long and two short fin-rays laid transversely, to show notochord.—*See end of this Appendix.*

Plate 12, page 179 to 183.—Left side.

Fig. 1.—Left pelvic bone, with part of right; lower or ventral aspect.

Fig. 2.—Left ventral fin, ventral appendage and ligaments.

Fig. 3.—Ventral fins, Codfish; lower or ventral aspect.

Fig. 4.—Ventral fins from young Salmon—upper or dorsal aspect.

Fig. 5.—Left of *5* is the small or superior Y shaped bone. Right of *5* is the larger or inferior Y shaped bone.

Fig. 6.—Left of *6* is the short bone (one of a pair) page 164. Right of *6* is the bone *e*, plate 10, page 175.—[Figs. 5 and 6 are from same fish as plate 11.]

In order to make plate 11 more clear, I have to add:

The spinal chord (myelon) passes upon the dorsal aspect of the centra, covered by a very strong sheath, which lies between the ventral extremities of the dorsal spinous rays until it reaches the end of the vertebræ, it there divides into two principal filaments which are inclosed in a wire at the anterior extremity of the upper or small Y shaped bone. One of these filaments lies upon the notochord, following it to its extremity, where it becomes minutely divided and lost in the general structure. The second or posterior dorsal wire, incloses the notochordal branch; the other I have not attempted to follow.

The notochord passes from the posterior edge of the spongy centrum (page 170) between the forks of two Y shaped bones, lying upon the upper edge of the superior and shorter one, and extends following the curve of the dorsal long fin ray at its superior edge, being overlapped by the longest of the short fin rays (in this specimen 2 inches in length) next to the long fin ray, a distance of $1\frac{1}{16}$ inches. The centre of the notochord being exactly half an inch from the dorsal edge of the caudal fin, where in plate 11 it is marked by a wire. The notochord where it issues from the forks of the superior Y shaped bone, in this specimen is nearly $\frac{1}{8}$ of an inch in diameter, decreasing a little in size until near its extremity, where it is slightly enlarged and has a somewhat blunt rounded termination; it is jointed in structure or rather shows the divisions which in the body of the fish form the centra.

The wire loop nearly in a line with the centre of the spinal column, plate 11, incloses the nervous corpuscle (page 170,) which receives filaments from a ganglion by a branch from the spinal chord.

On the left side of the tail, plate 10, figure 4, is shown the orifices of the pulsating? sack (page 170); the outer part of the

sack being turned up and marked by a wire. This sack is supplied by the vessel which passes through the orifices of the cup shaped bone mentioned on page 169.

Figure 4, plate 10, plate 11 as well as figures 5 and 6, plate 12 are taken from one fish, but not the fish from which my notes have been made and represented in the other plates. Between the bones protecting the notochord in these specimens, I find the following difference: in those of plate 1 the anterior bone (page 164) did not touch the posterior bone (page 175) but was separate some distance from it, the space between them being occupied by fascia; and the posterior bone was much shorter in proportion and much more strongly curved than that of the fish represented in plate 11.

The Artotypes illustrating this paper, are the work of Mr. W. D. O'Donnell, to whom the writer is much indebted for the care which he has bestowed upon them.

Dr. Sommers presented a specimen of Trillium sessile, collected by Miss Godfrey, of Clementsport, Digby County; he believed it was the first recorded instance of finding of the species in our Province. Trillium cerectum, T. erythrocarpum grows abundantly in many localities. T. cernuum not so frequent, and now Miss Godfrey has the honor of adding a fourth to the species of Trillium growing with us.


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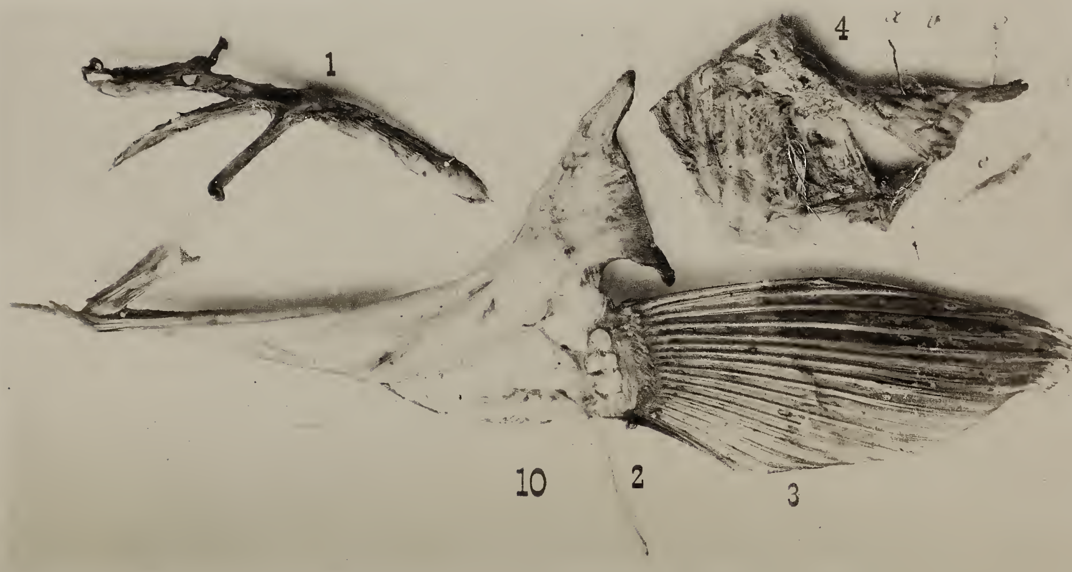
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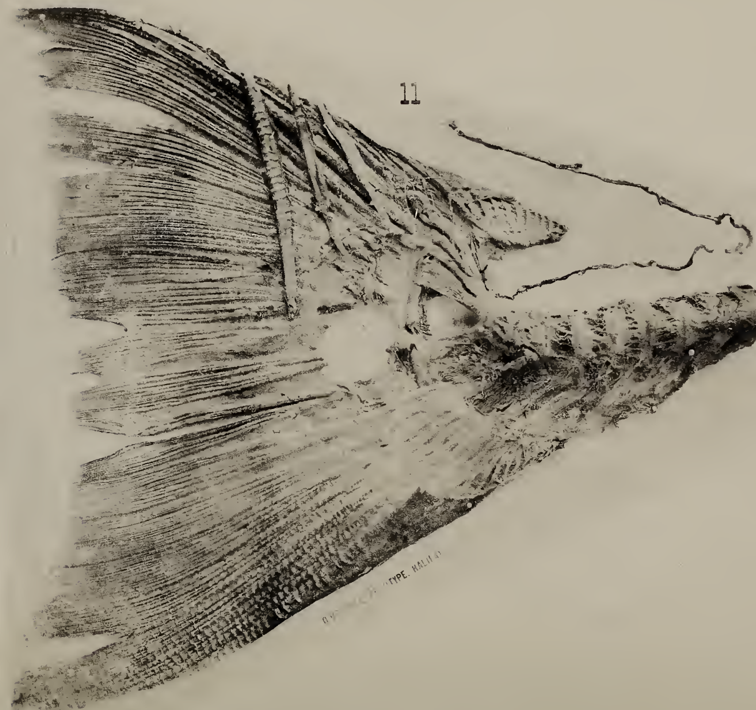

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Stewart Wallace
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The Anniversary Meeting of the Institute is held on the second Wednesday in October of every year.

The Monthly Ordinary Meetings of the Institute, when Papers are read, are held on the second Monday evening in every month, commencing in November and ending in May.